

The copyright of this thesis vests in the author. No quotation from it or information derived from it is to be published without full acknowledgement of the source. The thesis is to be used for private study or non-commercial research purposes only.

Published by the University of Cape Town (UCT) in terms of the non-exclusive license granted to UCT by the author.

A STROKE SERVICE MODEL
DEVELOPED IN THE PRIVATE SECTOR

by

LYNETTE K. R. KOW (M.B., Ch.B.)

KWXLYN 001

SUBMITTED TO THE UNIVERSITY OF CAPE TOWN
In partial fulfilment of the requirements for the degree

Master of Philosophy in Emergency Medicine

Faculty of Health Sciences
UNIVERSITY OF CAPE TOWN

Date: APRIL 2011

Supervisor[s]:

Bryan Kies: Associate Professor; Department of Neurology, University of Cape Town
Complex. (UCT Internal Co-supervisor)

Peter Jacobs: Emeritus Professor of Haematology: University of Cape Town

Professor of Internal Medicine: University of Omaha, Nebraska

Professor and Head: Division of Clinical Haematology, University of Stellenbosch.

Head: Department of Haematology, Constantiaberg Medi-Clinic (Thesis Co-supervisor)

Lee Wallis: Associate Professor; Division of Emergency Medicine: University of Cape
Town and University of Stellenbosch (Chief Supervisor)

DECLARATION:

I, Lynette Kayleen Rose Kow, hereby declare that the details within this dissertation / thesis is based on my own original work and contains no material that has been submitted or accepted for the award of any other degree or diploma in any educational institution that I am aware of. Furthermore, to the best of my knowledge and belief, it contains no material previously published or written by another person, except where due reference and acknowledgement has been made in the text of the thesis.

I empower the university to reproduce for the purpose of research either the whole or any portion of the contents in any manner whatsoever.

The research for this proposal received the approval of the Ethics Committee of the University of Cape Town.

Signed:

Dated:

ACKNOWLEDGEMENTS:

I would like to take the opportunity to thank the following people:

- Professor Jacobs: whose unerring care and consideration towards me never wavered. For the kindness and patience shown to me during the past year. And for the constant re-writing of this document.
- Professor Kies: who endured all my ignorance in writing this dissertation.
- Professor Wallis: for just being there.
- Dr. John Gardiner: for the help rendered with the stroke service at Constantiaberg Medi-Clinic and with the setting up of the clinical protocols in the Emergency Centre
- Dr Anneli Hardy from the Department of Statistics given to me in the revision and rewriting of this dissertation.
- Mr. Clive Lake, Hospital Manager at Constantiaberg Medi-Clinic, as well as all the staff involved in the stroke service.
- All the Physiotherapists, Occupational Therapists, Speech Therapists and Psychologist involved in the rendering of care within the stroke service
- And finally my family:
 - My mother for always standing by her children at all times
 - My sister, Daria, for her undying support for me on this long road in studying for this degree. Without her I would not have had the strength and courage to do this. Furthermore Daria was responsible for assisting me in finely planning the final draft of this proposal and then helping to put it all together and refine it.
 - My brother, Mark, for just being my brother.
 - My children, the lights of my life.

Total Word Count: 20 459

Number of Pages: 114

PREFACE:

This dissertation seeks primarily to enlighten the medical fraternity about the development of a stroke service at Constantiaberg Medi-Clinic and, additionally, how this has been implemented. The objective is to try to improve the outcome of patients presenting with various types and levels of neurological deficits as a consequence of cerebrovascular accidents.

The model has three consecutive components:

- The pre-hospital setting.
- Specialised care offered in the Emergency Centre.
- Long term rehabilitation.

These are a continuum with most of the emphasis being on the care given within the first 4 – 6 hours after onset of symptoms. Experience will allow recognition of the positive features as well as the shortcomings and culminate in a protocol sufficiently flexible to accommodate the advances in the care of cerebrovascular accidents as they become demonstrably available.

ABSTRACT:

BACKGROUND: Cerebrovascular disease is a worldwide problem. With the trend of the poorer population groups towards urbanisation, the rate of this entity is increasing. While strenuous efforts are made to educate people on prevention, many still succumb to strokes.

It is the responsibility of the health professional fraternity to explore ways of managing the lot of these unfortunate individuals. Here specialised units are both logical and practical in limiting the morbidity and mortality in the socio-economic setting, specifically that of the potentially devastating impact that severe stroke can have on the patients, their families and their carers.

METHOD:

This dissertation provides a description of the model developed at Constantiaberg Medi-Clinic and also includes details of the database that has developed especially for this service. The patient data has been collected during the period between 2008 and October 2010. Only the cases of cerebrovascular accidents who have been admitted to the hospital under the care of the neurologist and the physicians involved with the Stroke Service has been included in the study. The information collected thus far only includes the information as related to the patients while in hospital. Detailed analysis of various aspect of the database has been done and where possible comparisons have been made with the view to see whether it relates favourably in other centres. These will be discussed and reviewed in greater detail in the chapter concerned.

RESULTS:

Examination of the database shows that there are similar trends with the incidence of stroke with regards to sex differentiation, age variation, risk factors when examining the results seen from some other centres^{39,40,41}.

More detailed comparison of the co-morbidities note similarities between the Constantiaberg model and that described in the Renfrew / Paisley study in Scotland⁴¹ as well as the INTERSTROKE study⁴⁰.

There is only a small number of cases (15) within our database who fulfilled the criteria (and who agreed to) the administration of thrombolytics, the drug used being Intravenous recombinant tissue plasminogen activator commonly referred to tPA (Alteplase®). In light of the paucity of these cases, comparison cannot be made with the larger studies (the third International Stroke Trial IST-3^{43, 44}; and the third European Cooperative Acute Stroke Study ECASS -3⁴⁵). However, the recommendations provided by these large trials have been implemented here, in that tPA is given within the proposed 3 – 4 ½ hour time frame using the criteria as formulated.

University of Cape Town

TABLE OF CONTENTS:

1. Declaration	2
2. Acknowledgements	3
3. Preface	4
4. Abstract	5
5. Table of Contents	7
6. Chapter One: Introductory Overview	8
o Cerebrovascular accidents	9
o International Context	10
o South African Status	11
o WHO Perspective	12
o The Role of Urbanisation	13
o The Care Levels for Management of Stroke Victims	14
o Preventative Measures	15
7. Chapter Two: Background to Cerebrovascular Diseases	19
o Perspective of Chronic Disease Profile	20
o Preventative Measures	21
o Risk Factors and Treatment Guidelines	22
o Classification of Cerebrovascular Diseases	23
o Basic Anatomic Considerations	24
8. Chapter Three: International Context	29
o A Basic Model	30
▪ Australia	31
▪ United States of America	34
▪ United Kingdom	39
▪ Synopsis	42
o Financial Implications	43
o Outcomes of Specialised Stroke Units	44
9. Chapter Four: The Model at Constantiaberg Medi-Clinic	45
o Summary of the Constantiaberg model	46
o Pre-Hospital Involvement	47
o Emergency Care	48
o Secondary Phase Management	51
o Third Phase Aspects	53
o Related Support Structures	54
o Monthly Continuing Professional Development	55
10. Chapter Five: Discussion	62
o Historical Background	63
o The Local Model	65
o Comparisons between Australia, USA and UK	76
o The South African Context	79
11. Chapter Six: Review of Database	86
o Development of the Database	87
o Analysis of the Data	89
12. Chapter Seven: Summary	102
13. Bibliography	104
14. List of Addenda	111
15. List of Tables	112
16. List of Figures and Diagrams	113
17. List of commonly used abbreviations	114

CHAPTER ONE: INTRODUCTORY OVERVIEW

- **CEREBROVASCULAR ACCIDENTS**
- **INTERNATIONAL CONTEXT**
- **SOUTH AFRICAN STATUS**
- **WHO PERSPECTIVE**
- **THE ROLE OF HEALTH URBANISATION**
- **THE CARE LEVELS FOR MANAGEMENT OF STROKE VICTIMS**
- **PREVENTATIVE MEASURES**

CEREBROVASCULAR ACCIDENTS

Cerebrovascular accidents (CVA's) can be broadly divided into two main groups: thrombo-embolic events that results in either brain infarcts or Transient Ischaemic Attacks (TIA's), and cerebral haemorrhages.

STROKE

Stroke was defined by the World Health Organisation (WHO) in 1978 as *“rapidly developing clinical signs of focal or global disturbance of cerebral function lasting more than 24 hours or leading to death with no other apparent cause other than that of vascular origin”*.^{1, 3, 4}

TRANSIENT ISCHAEMIC ATTACK

Similarly, Transient Ischaemic Attack was defined as *“stroke symptoms and signs that resolve within 24 hours”*.^{1, 3, 4}

More recently with the addition of specialised imaging to assist in the management of CVA's this definition has become more refined. Also importantly the distinction between Ischaemic Stroke and TIA has become blurred as the pathogenetic mechanisms for the two conditions are similar.

Furthermore the treatment protocols for both follow similar lines.

The definition has now been fused into the following:

The diagnosis of stroke can be made in the presence of neurological symptoms and signs with associated imaging features of infarct although the clinical features may resolve within 24 hours.

By contrast, TIA can be diagnosed even 24 hours later if there are no signs of cerebral damage on imaging.²

CEREBRAL HAEMORRHAGE

The diagnosis of intracerebral haemorrhage is made mainly on radiological imaging where the presence of blood is noted outside the vascular bed.

INTERNATIONAL CONTEXT:

Cerebrovascular disease has emerged to be one of the leading causes of mortality and morbidity worldwide.

The WHO estimates that 15 million people worldwide globally suffer from stroke each year, with a 30 % mortality rate while an equal number of individuals are left paralysed as a result thereof.⁵ This, in turn, places a tremendous physical and emotional burden on the families of those afflicted and an associated financial and economic drain on the resources of the countries.

Examining the studies coming out of the more developed countries, the trend shows that the incidence of stroke is on the decline there.⁵ This has been accredited to the improved health education programmes aimed at lifestyle modification and the importance of improved management of hypertension, diabetes and hypercholesterolaemia as well as stricter dietary adherence with better understanding of the consequences of poor disease control.

SOUTH AFRICAN STATUS:

Matching data from South Africa are however unknown since no national stroke registry exists. Details extracted from the publication of the Medical Research Council (MRC) of South Africa entitled “*Chronic Diseases of Lifestyle in South Africa 1995 – 2005*” in the chapter on Stroke highlights the following points on the disease entity locally.⁶

Stroke is the fourth most common cause of death accounting for 6% deaths in 2000. When looking at the age groups over 55 years however, it has been found to be the commonest (the MRC /Wits (Agincourt) Rural Public Health and Health Transition Research Unit).^{7, 8}

The crude prevalence of Stroke was found to be 300 per 100 000 population.⁶

Comparison was made with similar studies in Tanzania and Auckland, New Zealand.⁸ Surprisingly it was found the prevalence of rural stroke was three times lower in South Africa as compared to New Zealand but double that compared to Tanzania. This would indicate a relatively lower number of people living with disabilities in South Africa, but the number of those requiring assistance with “at least one activity of daily living” is much higher locally thereby putting a higher burden on the community and consequently on the financial and socio-economic structure of the country.

According to the National Guidelines on Stroke and Transient Ischaemic Attack Management⁹ (released by the Department of Health), Stroke is the third most frequent cause of deaths reported in the country.

There also appears to be a wide difference in the spectrum in the figures for the different population groups. The higher rates have been noted in the Coloured and Indian population groups and the lowest have been found within the Whites. There are less well documented figures for the Blacks but the trend that has been noted is that they usually present at a younger age with stroke as a result of complications of hypertension and not related to the combination of hypertension, diabetes and raised cholesterol (as which occurs in the other race groups).⁵

WHO PERSPECTIVE

Statistics from the surveys done by the WHO from 1986 to 1997 indicates that approximately 33 in 100 000 South African Black males in the age group 20 to 54 years develop a stroke.⁵ This is highlighted in the figures and tables released by the WHO and shown on their website.¹⁰ See the accompanying excerpts from the WHO website (pages 16 - 17).

The table **COUNTRY COMPARISONS** (page 18) has been extracted from the same website showing the comparative figures from South Africa, United Kingdom, United States and Australia dated most recently as 2009. No later information is available.

Examining this table it is obvious that South Africa has almost the same mortality from stroke as compared to the other three countries used in the comparison. But what should be noted is the DALYS (Disability – adjusted Life Years) that differ vastly for South Africa. (The DALYS combine years of potential life lost due to premature death + years of productive life lost due to disability). As noted from the table, the DALYS from South Africa are almost three times higher than compared to that of the other three countries. Seeing that the rates of mortality are almost identical, it thus stands to reason that the most of the cases of stroke in South Africa result in varying degrees of physical disability (and not death), with a higher rate of residual morbidity with a concomitant burden on society in the form of loss of workforce and higher imposition on the economy.

It has been noted in a number of centres throughout the world that where there has been a concerted effort by various health professions to aggressively treat these patients in a more structured way, the outcomes and prognosis for these patients are more clearly defined. In so doing, stroke services have been developed and implemented along specific guidelines. Subsequent studies have shown that the outcomes for stroke patients and their carers and/or family members who can utilise these services are better as compared to those not able to access this type of service.

THE ROLE OF HEALTH URBANISATION

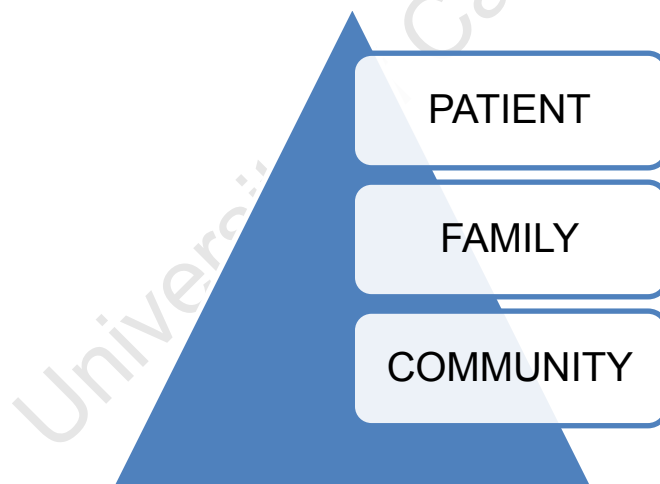
In the case of South Africa, the dual problem exists of one side of the population being exposed to the so-called diseases of the developed world (viz., hypertension, diabetes, hyperlipidaemias, and obesity) and all their consequent complications and the other side of the population falling victim to communicable diseases (viz., diarrhoea, malnutrition, HIV and tuberculosis, to name but a few). What is even more disconcerting is the overlap that is occurring between these two groups. The rural people that had been exposed to predominantly the infectious type of diseases are moving into the urban areas and then are becoming subject to the so-called chronic diseases concomitantly. In other words the poorer population groups are becoming “urbanised”. As well as exposure to the “developed world diseases” they have become more prone to the poor life style habits and dietary issues that face them (the poorer people) when they do reside in the larger towns and the cities.

Looking at the types of cerebrovascular diseases and the associated neurological deficits, it is easy to understand the physical, physiological, emotional, social and financial implications of increasing numbers of individuals suffering from these afflictions.

Added to this problem is the situation where more members from the poorer population groups with limited resources and financial capabilities are being afflicted. It is thus easy to see how this problem can become compounded and spiral out of control with a resultant tremendous burden on the health resources and on the economic status of the country.

THE CARE LEVELS FOR MANAGEMENT OF STROKE VICTIMS

Just the examination of the accompanying diagram highlights the burden that is faced sequentially by the patient, family and carers and the community overall. As can be seen from the diagram in a small proportion of cases, the patient him/herself can go back to some form of independent living, and in so doing limit the burden on the country's resources as well as emotional and physical strain on their families. A larger percentage of patients do require assistance of varying degrees from their families and in so doing access more resources from the country to this end. Finally the community plays an important role in the care and structure of the support for the large numbers of stroke victims. These invariably are the cases with more crippling disabilities who would utilize more experienced and dedicated care-givers. In most instances the level of care required would be outside what can be done at home. Also what can be noted is that the community should have the resources to be able to care for numerous cases simultaneously and at varying levels of disability. But this in turn places a burden on the finances of the health infrastructure.



PYRAMIDAL VIEW OF THE CARE LEVELS REQUIRED FOR STROKE VICTIMS.

PREVENTATIVE MEASURES

While the better solution to treating these complications would be the primary prevention by various well-documented methods, including control of blood pressure and blood glucose, cessation of smoking, and modifications of life style, many patients do end up with the complication of an ischaemic or haemorrhagic stroke. Consequently the health professional field has had to explore various ways to limit the aforementioned problems associated with cerebrovascular accidents (CVA's) and is constantly challenged to find ways to improve the plight of these individuals.

Undoubtedly the prevention of CVA would be the better option for the patient, family, carers and the community at large. Every attempt should be made to decrease the risks associated with the chronic diseases accompanying poor lifestyle. These are listed in the table (page 25) and described in the next chapter.

University of Cape Town

Global burden of stroke

"I waked and sat up...when I felt a confusion and indistinctness in my head which lasted, I suppose about half a minute. Soon after I perceived that I had suffered a paralytick stroke, and that my Speech was taken from me."
Samuel Johnson, England, 1783

Stroke is the brain equivalent of a heart attack. Blood must flow to and through the brain for it to function. If its flow is obstructed, by a blood clot moving to the brain, or by narrowing or bursting of blood vessels, the brain loses its energy supply, causing damage to tissues leading to stroke.

Annually, 15 million people worldwide suffer a stroke. Of these, 5 million die and another 5 million are left permanently disabled, placing a burden on family and community. Stroke is uncommon in people under 40 years; when it does occur, the main cause is high blood pressure. Stroke also occurs in about 8% of children with sickle cell disease.

The major risk factors for stroke are similar to those for coronary heart disease, with high blood pressure and tobacco use the most significant modifiable risks. Atrial fibrillation, heart failure and heart attack are other important risk factors.

The incidence of stroke is declining in many developed countries, largely as a result of better control of high blood pressure, and reduced levels of smoking. However, the absolute number of strokes continues to increase because of the ageing population.

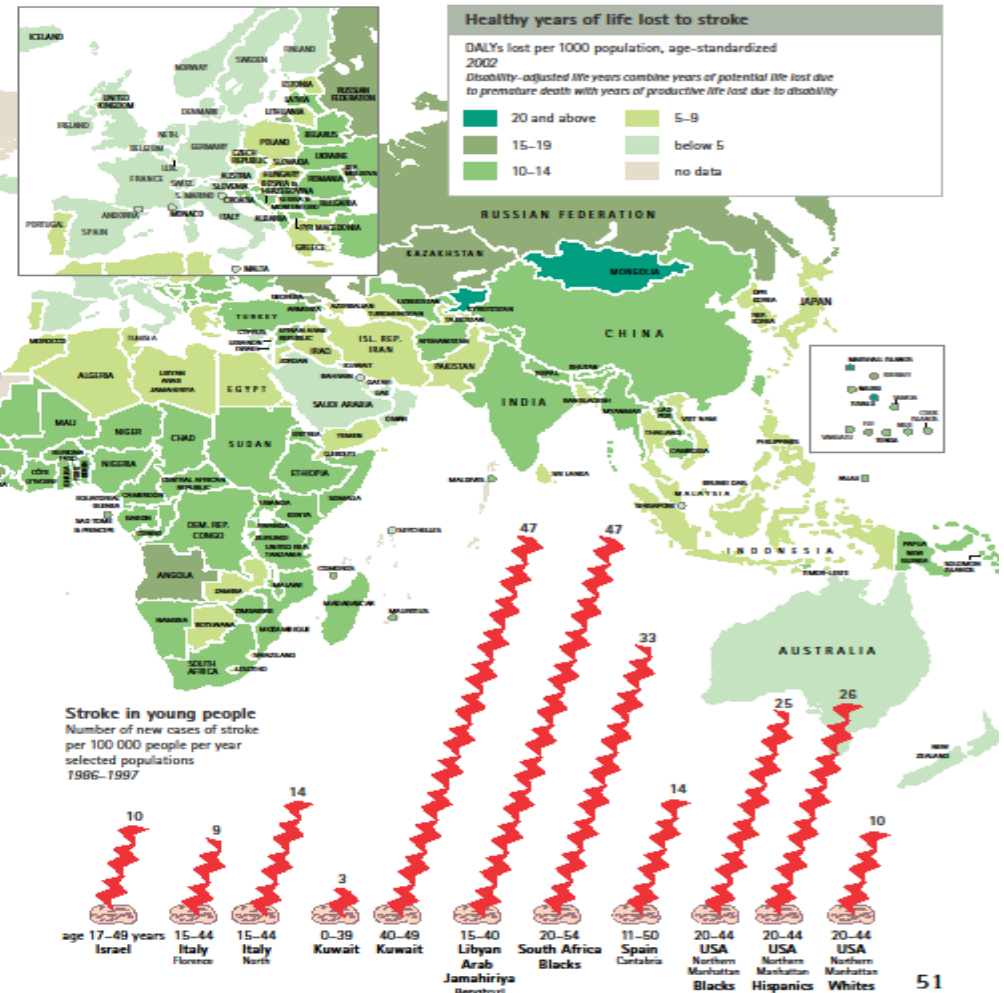


The increased risk of stroke from taking oral contraceptive pills is substantially reduced by using the modern, low-dose pill.

Stroke is the biggest single cause of major disability in the United Kingdom.

Treating hypertension can reduce the risk of a stroke by up to 40%.

Stroke burden is projected to rise from around 38 million DALYs globally in 1990 to 61 million DALYs in 2020.



This excerpt from the WHO website compares of the incidences of Stroke as well as the DALYS for different countries.

Deaths from stroke

Stroke carries a high risk of death. Survivors can experience loss of vision and/or speech, paralysis, and confusion. Historically called "apoplexy", "stroke" is so called because of the way it strikes people down.

Previous stroke significantly increases risk of further episodes. Certain racial, ethnic and socioeconomic groups are also at greater risk of stroke. The most important modifiable cause of stroke is high blood pressure; for every ten people who die of stroke, four could have been saved if their blood pressure had been regulated. Among those aged under 65, two-fifths of deaths from stroke are linked to smoking. Other modifiable risk factors include unhealthy diet, high salt intake, underlying heart disease, diabetes and high blood lipids.

The risk of death depends on the type of stroke. Transient ischaemic attack or TIA – where symptoms resolve in less than 24 hours – has the best outcome, followed by stroke caused by carotid stenosis (narrowing of the artery in the neck that supplies blood to the brain). Blockage of an artery is more dangerous, with rupture of a cerebral blood vessel the most dangerous of all.

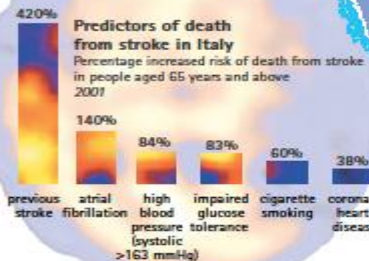
Even where advanced technology and facilities are available, 60% of those who suffer a stroke die or become dependent. Given these dismal statistics and the high cost of treatment of stroke, high priority should be accorded to preventive strategies.



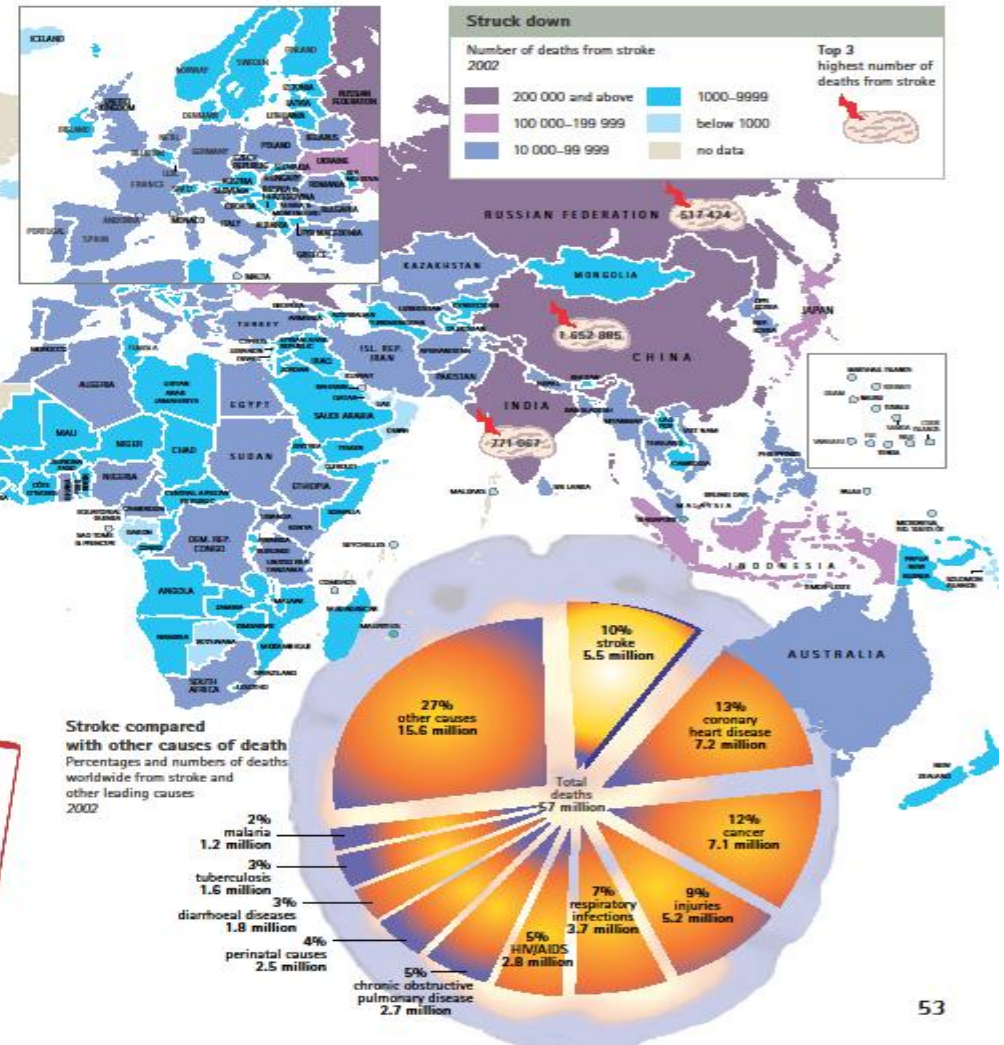
Stroke is the second leading cause of death above the age of 60 years, and the fifth leading cause in people aged 15 to 59 years old.

In the USA, someone dies of a stroke every three minutes.

Worldwide, 3 million women and 2.5 million men die from stroke every year.



Stroke is the third most common cause of death in developed countries, exceeded only by coronary heart disease and cancer.



This excerpt indicates the incidence of deaths resultant from Strokes worldwide, compared to other diseases/conditions.

COMPARISON TABLE ILLUSTRATING THE DALYS AND % DEATHS AMONG THE COUNTRIES STUDIED.

COUNTRY	Total Population	Stroke Disease			Heart Disease		
	In Millions	DALYS per 1000 population	Deaths (absolute values)	% deaths per population	DALYS per 1000 population	Deaths (absolute values)	% deaths per population
Australia	19 544	3	11 730	0.06%	5	25 474	0.13 %
United Kingdom	59 068	4	59 322	0.1%	7	120 530	0.2%
United States of America	291 038	4	163 768	0.06%	8	514 450	0.18%
South Africa	44 759	11	30 306	0.06%	9	27 013	0.06%

Statistics taken from the WHO website and based on figures indicated in the table of World Data Table.

DALYS: Disability – adjusted life years.

Source: World Health Organisation. (2009). *World Data Table*. Available:

http://www.who.int/cardiovascular_diseases/en/cvd_atlas_29_world_data_table.pdf. Last accessed 27th February 2011

CHAPTER TWO: BACKGROUND TO CEREBROVASCULAR DISEASE:

- **PERSPECTIVE OF CHRONIC DISEASE PROFILE**
- **PREVENTATIVE MEASURES**
- **RISK FACTORS AND TREATMENT GUIDELINES**
- **CLASSIFICATION OF CEREBROVASCULAR DISEASES**
- **BASIC ANATOMIC CONSIDERATIONS**

PERSPECTIVE OF CHRONIC DISEASE PROFILE:

With the ever increasing understanding and treatment of infectious diseases, the incidence of, and the morbidity and mortality related to these diseases has largely decreased worldwide in the more developed countries, leading to patients living longer. Consequently, more people are then becoming susceptible to the complications of the so-called chronic diseases, (viz., Diabetes Mellitus, Essential Hypertension, disorders of cholesterol metabolism) as well as the signatures of poor lifestyle of smoking, excessive consumption of alcohol, poor eating habits, and lack of regular proper exercise.

Many studies have been done by the Medical Research Council of South Africa, looking at the impact of these diseases on different groups of people based largely on geographical areas.¹¹ The overall impression is that the disease complexes noted here in South Africa run along similar lines to the same diseases found in the other three countries studied for this discussion.

PREVENTATIVE MEASURES:

Undoubtedly the ideal focus would be to prevent the onset of these complications by various means of lifestyle modifications with diet and exercise, stricter control of the diseases with compliance to the use of medications and abstinence from the abuse of various social drugs including alcohol and smoking. The risk factors for stroke have been tabulated (see Table: **RISK FACTORS AND ASSOCIATED TREATMENT GUIDELINES AND GOALS.** page 25)^{2, 9, 12, 13, 14, 15,}

When examining these risk factors, the doctors should vigorously explore all the available options to manage them in an attempt to prevent the onset of complications as outlined in the table. The majority can be treated medically and every effort must be made to garner optimal control.

Some of these risk factors unfortunately cannot be modified by any medical means. They are self – explanatory as described on the table.

RISK FACTORS AND TREATMENT GUIDELINES:

Obesity:

This is related to a number of other risks: hypertension, diabetes and dyslipidaemias. The goal is to attain a body mass index (BMI) of between 18.5 and 24.9 kg/m². Alternatively the waist circumference (<35 inches in women and <40 inches in men) can be used as a guideline.

Blood Pressure:

A major risk factor. The South African Hypertension Guidelines 2006⁹ indicates that the blood pressure (BP) target should be $\leq 140/90$.

Diabetes mellitus:

Also a major risk factor. The aim here (as described by the Lipid and Atherosclerosis Society of South Africa (LASSA)) should be for the Glycated Haemoglobin (HbA_{1c}) to be <7.¹⁵ If this test is not available then pre-prandial serum glucose levels of 4 – 7 mmol/litre or post-prandial serum glucose levels of 5 – 8 mmol/litre should be attained.

Hypercholesterolaemia:

The control parameter (also described by LASSA) in this modality is the Low Density Lipoprotein Cholesterol (LDLC); the recording of which should be ≤ 3 mmol/litre or at 45% of the initial elevated reading thereof.¹⁵

Smoking:

Cigarette smoking has been found to double the rate of CVA in smokers as compared to non-smokers. Furthermore an increase in rate has also been found in people that are exposed to environmental smoke (secondary smokers).²

CLASSIFICATION OF CEREBROVASCULAR DISEASES:

Cerebrovascular disease can be broadly divided into two main groups:

Haemorrhagic and Thrombo-embolic episodes. The former can be further divided into Sub-Arachnoid and Intracerebral Haemorrhages and the latter into Ischaemic infarcts and Transient Ischaemic Attacks. (See **SIMPLISTIC CLASSIFICATION OF CEREBROVASCULAR ACCIDENTS**. Page 26)

CLINICAL PICTURE OF STROKE

- Weakness or change in sensation of face or limb.
- Sudden change in vision with blurred or double vision.
- Dizziness or unsteady gait.
- Difficulty with speech or understanding.
- Sudden onset or change in character of headaches.

Thrombo-embolic Infarcts:

These are by far the commonest cause of cerebrovascular accidents accounting for up to 60 – 80 % of CVA's. The commonest site of the central nervous system involved is the area of the cerebrum supplied by the middle cerebral artery.

Haemorrhagic Strokes:

These are not as common as the thrombo-embolic episodes but are more catastrophic in nature with a higher rate of mortality than ischaemic infarcts.

Transient Ischaemic Attacks:

These are similar in pathogenesis to thrombo-embolic infarcts, the difference being that there is no radiological imaging changes noted in the brain.

The signs vary and are dependent on the site of the brain affected. The most common signs are visual disturbances, aphasia, hemiparesis, unilateral parasthesia, and occasional focal paralysis. A change in the level of consciousness is not common.

The commonest causes for TIA's are embolism (from atherosclerotic plaques), thrombosis (related to atrial fibrillation), and increased blood viscosity.

BASIC ANATOMIC CONSIDERATIONS:

Anatomy:

To understand the basis for the damage caused by CVA's the blood supply to the various parts of the brain needs to be examined. Blood supply to the brain is via two main bilateral blood vessels: the internal carotid (ICA) and the vertebral arteries. The ICA enters the skull vault anteriorly via the neck while the vertebral artery accesses the cranium posteriorly. Once within the cranium, the two vertebral arteries combine to form the basilar artery which in turn joins the ICA to form the Circle of Willis from which the main cerebral arteries supplying the brain originate.¹⁶

The Circle of Willis is vital as it is the site of most of the aneurysms responsible for sub-arachnoid haemorrhages (SAH).

See the accompanying figure: **VASCULAR SUPPLY TO THE BRAIN** (page 27).

Neuro-Anatomic Stroke Syndromes;

There are 4 principal neuro-anatomic stroke syndromes as well as the smaller lacunar infarct entities:

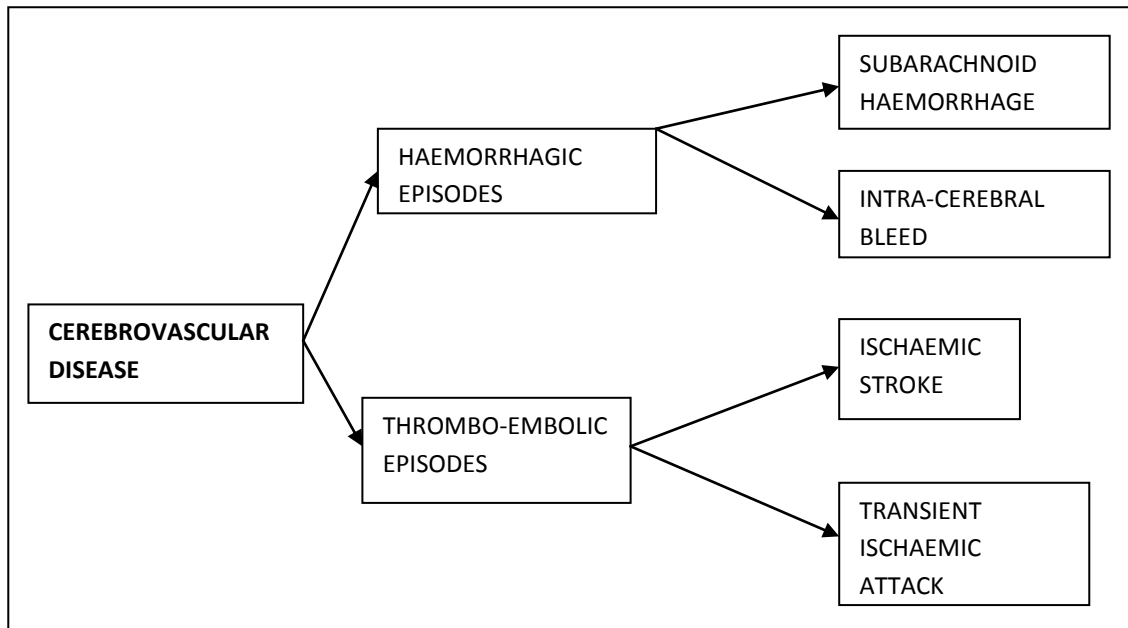
- Middle Cerebral Artery Occlusion.
- Anterior Cerebral Artery Occlusion.
- Posterior Cerebral Artery Occlusion.
- Vertebro-basilar Artery Occlusion.
- Lacunar Infarcts.

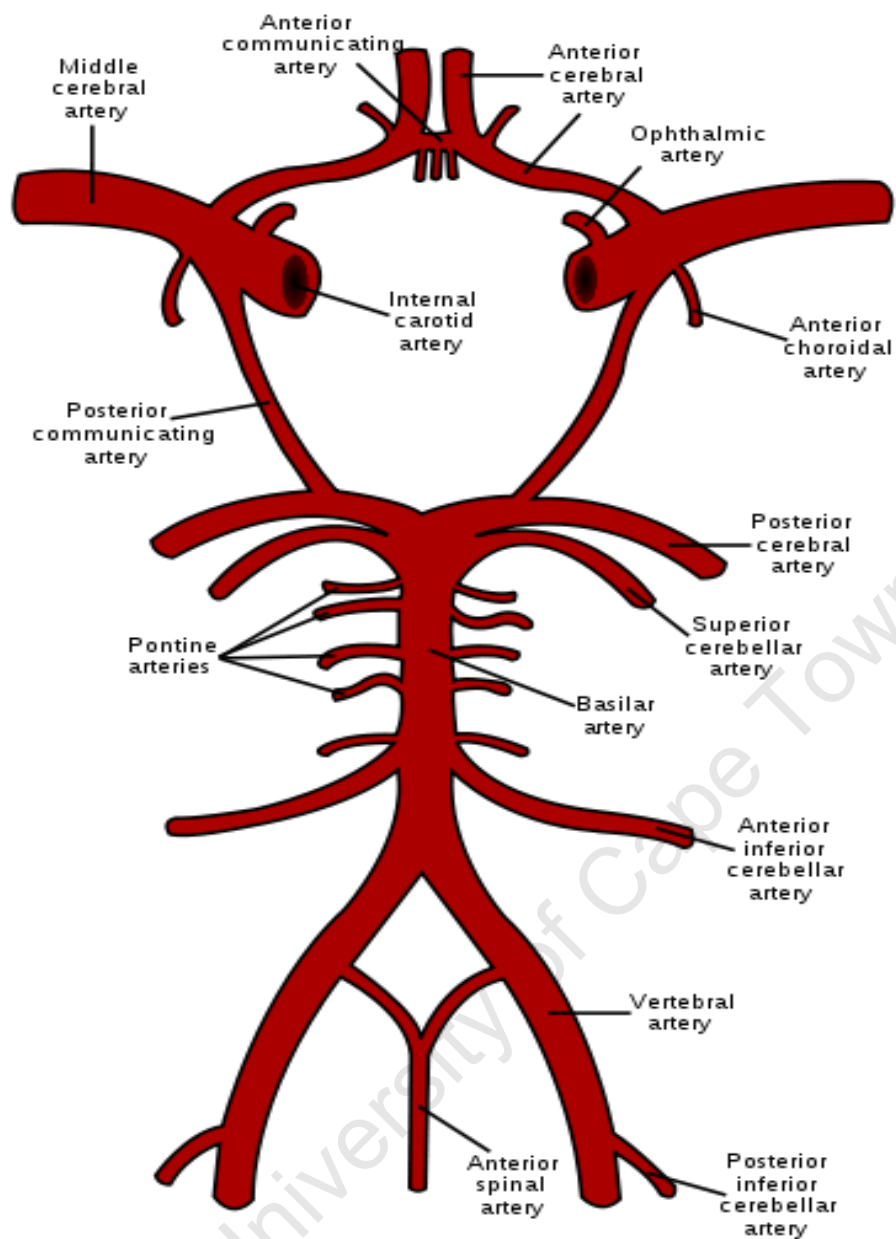
See the table **NEURO-ANATOMIC SYNDROMES OF STROKE** (page 28) for a further description of strokes based on anatomic guidelines.¹⁷ It gives an idea of the areas of the brain most affected by stroke, as well as an indication of the severity of the physical damage that can ensue.

RISK FACTORS AND ASSOCIATED TREATMENT GUIDELINES AND GOALS.

Risk Factor	Explanation and Treatment objectives
Age	Non- modifiable risk factor. Increase risk after 55 years.
Gender	Non-modifiable risk factor. 30% increase in incidence in women
Race	Non-modifiable risk factor. Increased morbidity in Blacks as result of hypertension
Obesity	This is related to other risk factors; a BMI of 18.5 – 24.9 is the aim.
Hypertension	30 – 40% risk reduction with BP lowering. To attain BP of 130/80 as the goal.
Diabetes Mellitus	Major risk factor. To reduce the blood sugar levels to 6.5 mmol/ litre.
Hypertension and Diabetes Mellitus combined	>40% reduction when tighter control of both diseases is strived for. BP control at 120/80 and sugar levels of ≤ 6.5 mmol/litre.
Tobacco smoking	Found to be a major risk factor in all sexes and across all age and race groups.
Alcohol	The effect somewhat controversial
Hypercholesterolaemia	Aim is to lower LDL to 1.8 – 3.4 mmol / litre. An associated decrease in stroke of up to 28% in stroke in patients on cholesterol lowering agents.
Heart disease with underlying arrhythmias	Risk for embolic stroke. Vigorous treatment of the underlying cardiac condition with anti-arrhythmic agents and anti-coagulant therapy if indicated.
Atrial Fibrillation	Risk for embolic stroke. Strict control of heart rate with concomitant anti-coagulants therapy.
Vasculopathic States	Various Connective tissue disorders, cocaine addicts, various vasculitis.
Hypercoagulopathes	Rare: Hereditary and congenital forms. Treat as required.
Human Immunodeficiency Virus Disease	HIV vasculitis can cause cerebral events

SIMPLISTIC CLASSIFICATION OF CEREBROVASCULAR DISEASE:





VASCULAR SUPPLY TO THE BRAIN

NEURO-ANATOMIC SYNDROMES OF STROKE

Blood Vessel involved	Anatomic area affected	Clinical features
Middle Cerebral Artery	Large portions of the Frontal, Parietal and Temporal Lobe Surfaces	Contralateral Hemiparesis (arms weaker than legs), dysarthria aphasia, hemianaesthesia, contralateral homonymous hemianopia, apraxia and sensory neglect
Anterior Cerebral Artery	Medial portions of the Frontal and Parietal lobes and the Corpus Callosum	Frontal lobe activity, primitive reflexes predominate, confusion, impaired judgement, legs weaker than arms, gait disturbances, urinary incontinence.
Posterior Cerebral Artery	Medial Temporal and Occipital lobes, Thalamus, Mammillary and Geniculate Bodies.	Visual and thought process disturbances, contralateral homonymous hemianopia, unilateral cortical blindness, impaired memory.
Vertebro-Basilar Artery	Brain Stem, Cerebellum, Posterior Cerebral Cortex, and Medial Temporal Lobe	Various Cranial nerves pathologies, cerebellar and brainstem defects, truncal or limb ataxia, spastic paresis, labile blood pressure.
Lacunar Infarcts	These are usually unilateral defects in the absence of any cortical abnormalities.	

CHAPTER THREE: INTERNATIONAL CONTEXT

- **A BASIC MODEL**
 - **AUSTRALIA**
 - **UNITED STATES OF AMERICA**
 - **UNITED KINGDOM**
 - **SYNOPSIS**
- **FINANCIAL CONSIDERATIONS**
- **OUTCOMES OF SPECIALISED STROKE UNITS**

A BASIC MODEL

The recommended guidelines for the development and implementation of stroke services in three other countries (Australia, United States and United Kingdom) have been examined. A composite model has then been formulated as to what should ideally comprise a stroke service unit. The description of this will follow after the details of the processes in the other three countries.

University of Cape Town

AUSTRALIA:

The delivery of acute stroke care management in Australia has been determined by the Stroke Foundation of Australia which is outlined in the document released in a paper called: "Acute Stroke Services Framework Summary 2008".¹⁸

Stroke is the second largest cause of death after coronary heart disease in Australia. The concept of specialised stroke services has been determined by using the recommendations of various stakeholders; viz., the National Stroke Program, the National Stroke Audit, various International comparisons and from work done by the local clinicians involved in the care of stroke victims.

The Australian model of a stroke service can be described as having a basic level of care with a more advanced option in areas with higher population groups:

The basic model entails:

- A dedicated team focussed on the management of stroke victims and comprising of the following health care professional groups: medical, nursing, speech therapy, physiotherapy, occupational therapy, social worker and dietician.
- Weekly team meetings to discuss the care of the current patients and other related issues.
- Co-ordinated care given by this team.
- Access to regular professional and educational development in the form of continuous professional development (CPD).
- Routine involvement of carers and support systems in the further chronic and ongoing care of these patients.
- Rehabilitation of stroke victims as soon as possible after the onset of symptoms and signs with the potential for this rehabilitation to continue for an undetermined time period.
- Development, implementation and use of clinical guidelines covering the care of stroke and transient ischaemic attack (TIA's).

The advanced model described would also include

- Intensive Care and / or High Care nursing facilities.
- Early supported discharge structures.
- Availability of advanced radiological imagery.

- Availability of Carotid Doppler facilities.
- Neurosurgical services.
- Focus on research development.
- Rapid TIA treatment assessment clinics.

In view of the geographical nature of Australia and the distances that some of the more rural residents would have to travel to seek appropriate medical care, the Stroke Foundation of Australia has sought to modify the above plan to accommodate this problem. The numbers of stroke cases per population (from the urban as well as the immediate surrounding rural areas) is the parameter used to determine the level of care designated by the stroke service in a particular area. The stroke facilities have been labeled from **Category A** to **Category D**. The more urbanised centres with large numbers of strokes (≥ 200 strokes from the urban areas and ≥ 120 strokes from the associated rural areas) have been labeled as **Category A**. These centres have all the facilities as described for the advanced service model. The centres designated as **Category D** have the least available facilities. The latter do, however, have protocols in place for the immediate urgent diagnosis and management of stroke followed by proper transfer and transport of these patients to the closest and appropriate larger **Category A** or **B** centres. Furthermore, Category D centres have 24-hour access (mainly telephonic) and educational support with the larger specialist centres.

The staffing guidelines have also been formulated:

- **Medical:** These health care workers should provide clinical care only and should include all levels of doctors from junior staff to senior doctors with a specialist neurologist as director of the service. This staffing should be complemented and supplemented by doctors that act in administrative, research or teaching roles.
- **Nursing:** Once again the predominant staff complement should be involved in nursing clinical care. More junior trained nursing staff should include enrolled nurses and assistants. Moreover there should be some of the nursing fraternity involved education, stroke service co-ordination and case manager tasks.
- **Para-medical structures:** These include the occupational therapists, physiotherapists, speech therapists, dieticians, psychologists, and social

workers. The numbers of these carers attached to the individual units are pre-determined by the number of cases seen within that centre.

UNITED STATES OF AMERICA:

Stroke is the third leading cause of death in the United States. It is also the leading cause of long term disability. More than 795 000 Americans suffer from a stroke annually with +/- 25% dying immediately thereof and then a further 20% left with varying levels of neurological deficit.^{19 ***}

Many individual centres throughout the United States have looked at this problem and have implemented their own protocols and plans to address this. But it has only been in the past 10 years, that a national stroke registry has been set in place in the USA to address the management of strokes as well as its impact on the country and its economy. The implementation of the National Stroke Registry followed the death of Senator Paul Coverdell from Georgia as a result of a stroke in 2001 while serving in Congress. The Congress of the United States thereafter charged the Centre for Disease Control (CDC) in Atlanta with the task of devising the registry and setting it in place.

The mission of the Paul Coverdell National Stroke Registry (PCNSR) is as follows (as an excerpt from the document on the CDC website)¹⁹:

- *Measure, track and improve the quality of care for acute stroke patients;*
- *Decrease the rate of premature deaths and disability from acute stroke through secondary prevention;*
- *Increase public awareness of stroke treatment and prevention; and*
- *Reduce disparities in acute stroke care by providing underserved populations with better access to such care.*

The PCNSR piloted eight prototype projects to test the models already implemented throughout the United States as to the level and quality of acute care given to the stroke victims. It had been noted that there was, in some instances, a tremendous disparity between the level of care given in the various centres and the recommended guidelines issued. Following these findings, the CDC funded certain identified state organisations to improve the services already provided and to close the gap in care that had been noted.

The clinical practice guidelines from the American Heart Association²⁰ are as follows:

- *The primary goals of rehabilitation are to prevent complications, minimise impairments, and maximise function.*
- *Secondary prevention is fundamental to prevent stroke recurrence.*
- *Early assessment and intervention is vital to provide optimal rehabilitation opportunities.*
- *A comprehensive treatment plan developed from standardised evaluation and assessment tools.*
- *Every patient is entitled to access to a multi-disciplinary treatment team.*
- *Support is given to patient's family and caregivers.*
- *Community resources for re-integration back into society are available for all victims.*
- *Ongoing medical management for the secondary risks factors are in place.*

The American Heart Association has further identified the "D's of Stroke Care" and these remain as the focal points for the diagnosis and management of strokes. Utilization of these factors will also serve to highlight the possible areas where delays can occur. The following excerpt is taken from the recently published 2010 AHA Guidelines²¹.

- **DETECTION:** *Rapid recognition of stroke symptoms*
- **DISPATCH:** *Early activation and dispatch of emergency medical services (EMS) system by calling 911*
- **DELIVERY:** *Rapid EMS identification, management, and transport*
- **DOOR:** *Appropriate triage to stroke centre*
- **DATA:** *Rapid triage, evaluation, and management within the emergency department (ED)*
- **DECISION:** *Stroke expertise and therapy selection*
- **DRUG:** *Fibrinolytic therapy, intra-arterial strategies*
- **DISPOSITION:** *Rapid admission to stroke unit, critical care unit.*

The Brain Attack Coalition is a multidisciplinary group of health care professionals who are intimately involved in the care of stroke victims. This group used a comprehensive literature search and from this information managed to evolve a format by which primary stroke centres (PSC) and comprehensive stroke centres (CSC) be developed^{22, 23}.

The recommendations for the establishment of Primary Stroke Centres follows along 11 aspects as described below:

- **ACUTE STROKE TEAMS:** These are dedicated teams available on a 24-hour basis within a hospital setting, having the capability being able to evaluate a potential stroke victim within 15 minutes of receiving such a patient.
- **WRITTEN CARE PROTOCOLS:** These should include treatment guidelines on the rapid and accurate management of stroke patients with the aim to reduce time delays.
- **EMERGENCY MEDICAL SERVICES:** This indicates the need for a rapid and appropriate transport of affected patients to the nearest stroke facility. A cornerstone of this aspect is good communication lines between the EMS and the acute stroke teams at the emergency centres.
- **EMERGENCY DEPARTMENTS:** This should be staffing trained in the acute management of stroke and should from the liaison between the EMS and the acute stroke team.
- **STROKE UNIT:** A dedicated ward or area within the hospital where the cases are managed with specialized monitoring and care
- **NEUROSURGICAL SERVICES:** This service should be available within two hours of the patient requiring it if deemed necessary.
- **SUPPORT OF MEDICAL ORGANISATION:** All levels of hospital staff including administration and education should be involved in the provision of stroke service.
- **NEURO-IMAGING:** Availability of at least CT scanning of the brain should be available within 25 minutes of request and be evaluated by the relevant acute stroke service provider within 20 minutes of completion of the scan.
- **LABORATORY SERVICES:** Standard laboratory testing should be available 24 hours a day, seven days a week at the Primary Stroke Centre.
- **OUTCOMES / QUALITY IMPROVEMENT:** A database should be developed to register, monitor and track all cases presenting at the centre.
- **EDUCATIONAL PROGRAMMES:** It is recommended that the staff of the stroke centre receive at least 8 hours per year of continuing medical education to enhance their knowledge of strokes and to keep up to date with international developments. Furthermore, at least two public drives or campaigns should be launched for public education and information sharing.

Following on the recommendations by the BAC for the development of the PSC, the need then arose for a facility to care for the cases who present with complex stroke types, multiple organ diseases and severe deficits. To this end, a comprehensive stroke centre was defined.

A summary of the requirements for this follows:

PERSONNEL AND CLINICAL EXPERTISE:

- Centre Director
- Neurologists and Neuro-surgeons
- Vascular surgeons capable of performing carotid endarterectomy
- Physicians with the expertise in performing neuro-radiological procedures.
- Emergency centre staff with liaisons with EMS
- Radiological technologists
- Specially trained nursing staff including critical care nurses
- Intensivist Physicians with experience in Ultrasonography and Doppler studies.
- Physio – and occupational therapists
- Social workers and care workers.

SPECIALISED DIAGNOSTIC AND TREATMENT TECHNIQUES:

- CT Scanning
- MRI Scanning
- Angiographic studies
- CT Angiography
- Ultrasonography
- Transcranial Doppler Studies
- Transthoracic and Transoesophageal Echocardiography

FACILITY INFRASTRUCTURE:

- Emergency Medical Services
- Emergency Centres
- Referral guidelines and Triage protocols
- Stroke Unit and Critical Care Unit
- Rehabilitation and Post Stroke Care

EDUCATION AND RESEARCH PROGRAMMES:

- Educational Programmes both for staffing as well as for the community
- Research studies.

UNITED KINGDOM:

About 110,000 people die annually in the UK as a result of stroke which is the third largest cause of death there²⁴.

The Department of Health in the UK working in conjunction with the National Health System (NHS), formulated the National Stroke Strategy (NSS)²⁴ in December 2007. This has become the guideline used there.

The scope of the NSS is as follows (excerpted from the document):

- *Provide a quality framework against which local services can secure improvements to stroke services and address health inequalities relating to stroke over the next ten years;*
- *Provide advice, guidance and support for commissioners, strategic health authorities, the voluntary sector and social care, in the planning, development and monitoring of services; and*
- *Inform the expectations of those affected by stroke and their families, by providing a guide to high-quality health and social services.*

20 Quality Markers are identified and used as the mainstay of this strategy.

1. *Awareness Raising: The general public are able to quickly recognise and identify the clinical picture of stroke and are aware that it is a major medical emergency.*
2. *Managing Risk: All patients are examined for risk factors and are managed as per national recommendations for treating hypertension, diabetes and hypercholesterolaemia. Modifications to life style changes are also encouraged.*
3. *Information, advice and support: Affected patients and their families have support to various care facilities ranging from emotional to physical problems.*
4. *Involving individuals in developing services: Feedback and advice is encouraged from the individuals who have suffered from stroke so that this can be implemented into future guidelines.*
5. *Assessment and referral to specialist: People that have experienced a TIA should be referred to a specialist as a matter of urgency for a full assessment as well as specific radiological imaging and appropriate intervention as indicated.*

6. Treatment: *All patients with a TIA or minor stroke receive pre-determined follow-up care.*
7. Urgent response: *All patients with suspected major stroke are referred urgently to a stroke service capable of providing hyper-acute care with the use of radiological imaging and intravenous thrombolytic therapy.*
8. Assessment: *Stroke Victims receive the immediate treatment as per recommended guidelines from the properly trained staff.*
9. Treatment: *All stroke victims are treated in specialised stroke units. These will be described later.*
10. High-Quality Specialist rehabilitation: *Stroke victims should have easy and rapid access to high-quality rehabilitative services.*
11. End-of-life care: *Patients who have an extremely proper quality of life after a stroke should be able to receive the necessary care required.*
12. Seamless transfer of care: *Clearly defined treatment plans involving all facets of care for the patients and their families have been outlined.*
13. Long- term care and transport: *All the long-term support services are easily accessible to all patients.*
14. Assessment and review: *Stroke patients and their families receive follow-up visits within six weeks after the event. Further check – ups are routinely scheduled.*
15. Participation in community life: *Patients are encouraged to live full lives within their respective communities.*
16. Return to work: *Stroke victims are encouraged as far as possible to garner full paid employment.*
17. Networks: *Networks are developed for covering up to 2 million people to deliver stroke care therein.*
18. Leadership and Skills: *Correctly trained staff are present to cope with stroke victims.*
19. Workforce review and development: *Skills training is encouraged.*
20. Research and Audit: *Quality research and regular audits should be a mainstay as part of the service.*

The acute stroke service provision in the United Kingdom can now be described using the following guidelines:

- Appropriate management and treatment.
- Access to specifically trained physiotherapists, speech therapists, and dieticians.
- Critical care facilities for those patients that do require intensive monitoring.
- Specialists with a special interest in CVA's.
- Open channels of communication with patients, families and care givers, and the FP's of the patients.

University of Cape Town

SYNOPSIS:

Looking at what has been described above; a composite model can now be formulated. The minimum standards for management of stroke victims are as follows:

- Dedicated area within the hospital to manage stroke victims.
- Dedicated multi-disciplinary team with members having a special interest in stroke and its rehabilitation.
- Standardised Protocols in place for the management of Strokes and Transient Ischaemic Attacks.
- Regular meetings by the multi-disciplinary team to discuss patient care and related topics.
- Support given to carers of stroke victims during the rehabilitation process.
- Early acute intervention and onset of rehabilitation that continues for an extended period of time.

The more advanced components of the standards include:

- Onsite intensive and / or high care units with the focus on managing acute stroke victims.
- Rapid access to onsite radiological imagery in the form of Computerised Tomography and Magnetic Resonance Imaging.
- Access to Carotid Doppler Sonography.
- Capacity for intensive monitoring of the stroke victims during the critical first 48 hours.
- Standardised protocols for managing and assessing patients who have presented with Transient Ischaemic Attacks.

FINANCIAL CONSIDERATIONS:

AUSTRALIA:

The NEMESIS study was done in the greater Melbourne area. From this study various information streams were deduced. One of these was looking at the cost involved in the management and care of strokes. It is noted that the cost (2001 figures) indicates that most of the cost is borne within the first 12 months of rehabilitation: average cost per life in the first 12 months is Aus\$ 18 956 and over the lifetime A\$ 44 428. So it can be deduced that most of the costs involved are incurred **after** the initial treatment phase²⁵.

UNITED STATES:

Direct and indirect costs in the care of stroke victims were looked at. Data on the direct cost of treating stroke was obtained from Medicare claims details, the 1987 National Medical Expenditure Survey (NMES) and insurance claims. Data on the indirect costs (associated with premature mortality and morbidity) was derived from the USA Bureau of Economic Analysis and the 1987 NMES. Indirect costs were estimated to be 58% of the total amounts incurred²⁶. It has been predicted that the costs of stroke care in the USA in 2007 would be in excess of \$51 billion.

UNITED KINGDOM:

According to the statistics released by the NHS²⁴, stroke costs the British economy about £7 billion a year (2007 figures), which comprises £2.8 billion in costs to the NHS, £2.4 billion in costs of care of these patients and a further £1.8 billion lost in productivity and disability. Stroke mortality is decreasing here and hence it can be deduced that these figures are set to rise as the costs for care of the stroke victims look likely to rise.

OUTCOMES OF THE SPECIALISED STROKE UNITS:

Looking at multiple studies done on the outcomes from admissions to or care by specialised stroke services or centres, it is noted that the mortality and morbidity (M&M) from these is not much higher than when patients are admitted to general medical wards.

Findings from the Yale Stroke Program published in 1995²⁷ showed that specialised treatment given to stroke victims did reduce the length of stay, reduced the complication of urinary tract infections but did not affect the overall mortality rates.

A review of 31 trials done by the Stroke Unit Trialists' Collaboration at the University of Glasgow in 2001²⁸, depicted a decrease in M&M in the specialised units with no concomitant increase in the length of stay. It also showed that patients subjected to this level of care were more likely to return to a higher level of independent living when measured one year after the event.

Examining the randomised control trial (RCT) done by Patel, et.al. in 2000²⁹, it can be noted that even though the costs of care in specialised units were considerably higher, the outcomes regarding M&M were much better.

Recommendations by the Brain Attack Coalition (BAC) in 2005³⁰ highlight the importance of an integrated system approach to stroke victims. The components of the comprehensive stroke centre (CSC) include:

- Specifically trained personnel.
- Specialised radiological imaging.
- Proper facility infrastructure.
- Various educational bodies.

This has been described in more detail above when discussing the models recommended and implemented in the United States of America.

The BAC observed that the integration of the services as described would be more costly but would lead to improved outcomes and therefore still recommended the implementation of these CSC.

In summary, the development of the services does not alter the overall M&M of stroke patients but does improve the chance of them returning to a higher level of everyday living.

CHAPTER FOUR: THE STROKE SERVICE MODEL AT CONSTANTIABERG MEDI-CLINIC

- **SUMMARY OF THE CONSTANTIABERG MODEL**
- **PRE-HOSPITAL INVOLVEMENT**
- **EMERGENCY CARE**
- **SECONDARY PHASE MANAGEMENT**
- **THIRD PHASE ASPECTS**
- **RELATED SUPPORT STRUCTURES**
- **MONTHLY CONTINUING PROFESSIONAL DEVELOPMENT**

SUMMARY OF THE CONSTANTIBERG MODEL:

The stroke service at Constantiaberg Medi-Clinic has generally followed the outline of the composite model derived from that seen in the other countries discussed in the earlier chapter.

First phase care:

- Pre-Hospital care
 - The family doctors (or general practitioners).
 - The Emergency Medical Services (ambulances).
 - Client Service Management (Public Relations).
 - Network Marketing Management.
- Emergency medical care.
 - Clinical History.
 - Clinical Examination.
 - Bedside tests.
 - Initial Management.
 - Specialised investigations.
 - Initial drug therapy.
- Acute Nursing care given with the emergency centre.

Second phase care:

- Neurologist / physician.
- Post-acute ward nursing care.

Third phase care:

- Dedicated Physiotherapist.
- Dedicated Occupational Therapist.
- Speech Therapist.
- Psychologist
- Dietician.

Related support structures:

- Hospital Counsellor.
- Support Groups comprised of family members and stroke survivors.
- Other ancillary services (including client services, and network marketing).

PRE-HOSPITAL INVOLVEMENT:

The family doctors (or general practitioners):

These doctors (FP's or GP's) refer their patients to the stroke unit directly. The patients are sent using the most appropriate, quickest means of transfer. In many cases, the doctors may refer directly to the neurologist or the physician who in turn requests that the patient be seen in the Emergency Centre first where rapid initial assessment and management can occur.

They (FP's or GP's) thereafter play an important bridging supportive role when the patients get discharged to the community based rehabilitation care. They also provide emotional care to patients, family and caregivers.

The Emergency Medical Services (EMS):

The ambulance staffing of the various services are vital in getting the patients to hospital as soon as possible. Initial management of these patients can occur in the EMS as intravenous access and blood glucose is monitored.

Client Service Management:

The client service manager and the client service officer employed by the hospital play a vital role in the advertising and awareness campaigns to highlight the function and the role of the stroke service.

Network Marketing Management:

The role of this person is to provide an important link between the service, the family practitioners (FP's), and the specialist consultants involved in the stroke service. In essence this responsibility is to promote and advertise the service.

EMERGENCY CARE:

This is where the acute urgent treatment is provided to patients presenting with a stroke. The nursing staff are usually the first health professionals to have contact with the patient in the emergency centre. In some cases the receptionists are the first contacts. They have been educated to identify these patients and quickly and discreetly inform the staff of the arrival of these patients. If the emergency centre has been forewarned the doctor on duty will be expecting the arrival of the patient and is involved immediately.

The clinical history:

Salient points are elicited quickly and focussed on:

- Time of onset of symptoms.
- Degree of motor or obvious sensory impairment.
- Speech problems.
- Swallowing difficulties.
- Change in the level of consciousness.
- Confusion.
- Seizures.
- Pre-morbid intellectual state of the patient.

Added information is obtained to ascertain the details for the modified Rankin Scale as a pre-morbid indicator for functionality³¹. See the accompanying table (page 56). This importance of ascertaining the pre-morbid mRS is so that it can be used during the hospital phase as well as on discharge as an indicator of the progress (be it an improvement or a worsening) of the patient's condition.

Full background medical history with emphasis on previous TIA's or any other vascular disease as well as a detailed medication list is elicited.

The clinical examination:

A complete evaluation of the patient is done examining all the systems of the body but with a special focus on the neurological system. The full approach to cerebrovascular disease has been devised and developed in conjunction with the neurologist and the doctors in the emergency centre. (see page 57)

- The vital observations are recorded. The following deviations from the observations are actively looked for and documented:
 - Pulse (Atrial Fibrillation or any other forms of irregular cardiac rhythms);
 - Blood Pressure (abnormally elevated systolic blood pressure (>160mm Hg) or elevated diastolic blood pressure (>100mm Hg));
 - Temperature (>38°C);
 - Respiratory rate (< 12 or > 30 breaths per minutes);
 - O₂ saturation (< 92%).
- Examination of the rest of the systems to actively look for signs of other vascular disease:
- The level of consciousness of the patient noted and documented.
- Neck stiffness.
- The exact degree of limb weaknesses.
- The patient's ability to walk or not.
- Examination and documentation of the sensory system.
- The cranial nerves assessment.
- Cognitive function testing.
- Evaluation of the patient using the National Institute of Health Stroke Services (NIHSS) scales²⁹. See the attached NIHSS scales (pages 58 - 60).
- Evaluation of the patient using the ABCD² scale in the event of a suspected TIA³⁰ (see page 61).

Bedside testing:

- Haemoglucotest and Haemoglobin
- Urinalysis.
- Electrocardiogram done routinely.

Initial Management:

The initial management is mainly supportive.

Formal Laboratory testing:

The minimum tests should include the following:

- Full Blood Count: Haemoglobin, white cell count and platelet count.
- Prothrombin and partial prothrombin times.
- Formal laboratory blood glucose.
- Renal function tests: urea, electrolytes and creatinine.
- Liver Functions tests.
- C-reactive protein.
- INR if the patient is on Warfarin therapy.
- Arterial blood gases.
- Urine Microscopy, Culture and Sensitivity if an abnormal urinalysis was documented.

Radiologic evaluations:

This is done in consultation with the specialist neurologist or physician.

- Computerised Tomography (CT) scan: Usually done at night or over weekend to exclude the presence of haemorrhage.
- Magnetic Resonance Imaging (MRI) scan: this more sensitive test is performed during office hours.
- MRI Angiography (MRA): this is the scan to look for berry aneurysms that result in SAH, as well as to determine any other vascular abnormalities (e.g. Carotid Artery Stenosis)

INITIAL DRUG THERAPY:

The initial drug therapy depends largely on the presenting signs: Treatment of pyrexia, dehydration, vomiting and nausea.

Further drug treatment depends on the presence or not of cerebral bleeding.

ACUTE NURSING CARE:

This is done by those in the emergency centre. They give initial supportive care, commence emergency drug therapy and thrombolytic drugs if so ordered.

The further elements of the Constantiaberg Stroke service will be briefly mentioned here.

SECOND PHASE MANAGEMENT:

Neurologist or Physician:

The care rendered by this person actually starts in the emergency centre with the decisions surrounding the choice of radiological imagery and the possible administration of tPA. This treatment is extended into the post-acute general ward and beyond with the decision around and the implementation of rehabilitation.

Post-acute nursing care:

The supportive care initiated in the emergency care is continued when the patient reaches the general ward. Input is now more focussed on rehabilitation and prevention of complications. Care is given towards urinary tract care, pressure area care, swallowing problems and assistance with mobilisation of the patient. The latter is done in collaboration with the physiotherapists and occupational therapists.

The role of Thrombolysis:

The decision to administer thrombolytic agents (tPA being the drug of choice) rests mainly on the consultant neurologist or physician involved in the care of the patient.

There are a variety of factors that are integral to this process:

- The patient has to present within the 3 – 4.5 hour time frame (in the earlier part of the service, the cut-off time was 3 hours but latterly, this has been extended to 4.5 hours in keeping with the more recent international recommendations)
- The CT scan done is found to be normal; i.e., no evidence of intracranial bleeding and no infarcted brain tissue.
- No contra-indications to the administration of thrombolytics.
- mRS and NIHSS are carefully recorded.
- Exact Neurological deficits are notarised.

Once the decision has been made that the patient is likely a candidate for thrombolysis, the patient and family members is consulted, and fully advised on all the details surrounding this plan of treatment, including the risks and possible failure of the therapy. In most of the cases, the decision is made by the family.

tPA is administered in the Emergency Centre by the nurses there, under orders of the doctors. It is given in weight dependent doses using a syringe driver over 30

minutes. The patient remains in the resuscitation area of the Emergency Centre while this is in progress and for a further 40 - 60 minutes thereafter. Close monitoring of Blood Pressure, heart rate recordings, attention to any possible bleeding sites (IVI site) and alterations in neurological symptoms and signs.

The patient then is transferred to a general medical ward for the ongoing secondary phase management.

University of Cape Town

THIRD PHASE ASPECTS:

This can be discussed collectively. The input of the care delivered by these health care professionals commence once the patient reaches the ward. It is also largely dependent on the clinical condition of the patient and the expected outcome for that patient. These professionals will continue their treatment with the patient to beyond the discharge from the hospital.

University of Cape Town

RELATED SUPPORT STRUCTURES:

This is the long term section of the stroke service.

Hospital Counsellor:

Support from this individual starts in the emergency phase of care and continues when the patient is discharged. Care, on an *ad hoc* basis, is rendered to the family and care givers as well.

Stroke Support Group:

This comprises stroke survivors and family members. They meet monthly to discuss various issues and plan different activities that are related to problems associated with the day-to-day living of a stroke survivor, as well as the struggles experienced by the families of such patients.

University of Cape Town

MONTHLY CONTINUING PROFESSIONAL DEVELOPMENT MEETINGS:

The group of health professionals meet monthly to discuss issues related to the different cases that had presented to the hospital over the previous month.

Full discussion of the Stroke Service will follow in the next chapter.

University of Cape Town

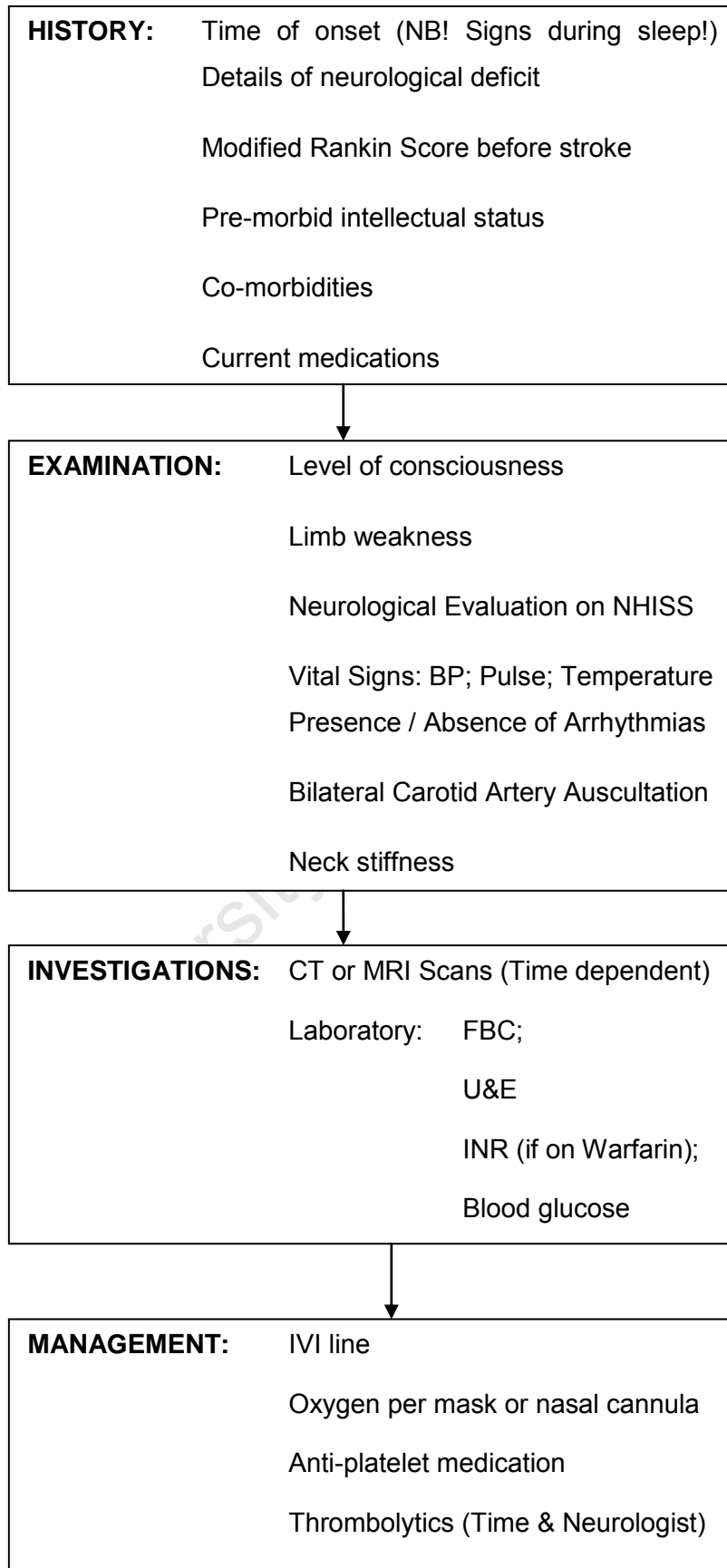
MODIFIED RANKIN SCALE^{31,32,33,34}

SCORE	DESCRIPTION
0	No symptoms at all
1	No significant disability despite symptoms; able to carry out all usual duties and activities
2	Slight disability; unable to carry out all previous activities, but able to look after own affairs without assistance
3	Moderate disability; requiring some help, but able to walk without assistance
4	Moderately severe disability; unable to walk without assistance and unable to attend to own bodily needs without assistance
5	Severe disability; bedridden, incontinent and requiring constant nursing care and attention
6	Dead

TOTAL (0–6): _____

The mRS is self explanatory. The lower the score, the more independent living the patient is.

AN APPROACH TO CEREBROVASCULAR DISEASE:



NATIONAL INSTITUTE OF HEALTH STROKE SCALE:

Check ☒ **one** response for each NIHSS item

1. a. Level of Consciousness:

- 0 ☐ Alert
- 1 ☐ Not alert, but arousable with minimal stimulation
- 2 ☐ Not alert, requires repeated stimulation to attend
- 3 ☐ Coma

1. b. Ask patient the month and their age:

- 0 ☐ Answers both correctly
- 1 ☐ Answers one correctly
- 2 ☐ Both incorrect

1. c. Ask patient to open and close eyes:

- 0 ☐ Obeys both correctly
- 1 ☐ obeys one correctly
- 2 ☐ Both incorrect

2. Best Gaze (Only horizontal eye movements):

- 0 ☐ Normal
- 1 ☐ Partial Gaze Palsy
- 2 ☐ Forced deviation

3. Visual Field Testing:

- 0 ☐ No Visual field loss
- 1 ☐ Partial Hemianopia
- 2 ☐ Complete Hemianopia
- 3 ☐ Bilateral Hemianopia (blind, including cortical blindness)

4. Facial Paresis (Ask patient to show teeth or raise eyebrows and close eyes tightly):

- 0 ☐ Normal symmetrical movement
- 1 ☐ Minor paralysis (flattened nasolabial fold, asymmetry on smiling)
- 2 ☐ Partial paralysis (total or near total paralysis of lower face)
- 3 ☐ Complete paralysis of one or both sides (absence of facial movement in upper and lower face)

5. a. Motor function – Right Arm:

- 0 ☐ Normal (extend arm 90° or 45° for 10 seconds without drift)
- 1 ☐ Drift
- 2 ☐ Some effort against gravity
- 3 ☐ No effort against gravity
- 4 ☐ No movement
- 9 ☐ Untestable (joint fused or limb amputated)

5. b. Motor function – Left Arm:

- 0 ☐ Normal (extend arm 90° or 45° for 10 seconds without drift)
- 1 ☐ Drift
- 2 ☐ Some effort against gravity
- 3 ☐ No effort against gravity
- 4 ☐ No movement
- 9 ☐ Untestable (joint fused or limb amputation)

6. a. Motor function – Right Leg:

- 0 ☐ Normal (hold leg in 30° position for 5 seconds)
- 1 ☐ Drift
- 2 ☐ Some effort against gravity
- 3 ☐ No effort against gravity
- 4 ☐ No movement
- 9 ☐ Untestable (joint fused or limb amputation)

6. b. Motor function – Left Leg:

- 0 ☐ Normal (hold leg in 30° position for 5 seconds)
- 1 ☐ Drift
- 2 ☐ Some effort against gravity
- 3 ☐ No effort against gravity
- 4 ☐ No movement
- 9 ☐ Untestable (joint fused or limb amputation)

7. Limb Ataxia

- 0 ☐ No Ataxia
- 1 ☐ Present in one limb
- 2 ☐ Present in two limbs

8. Sensory (Use pinprick to test arms, legs, trunk and face – compare side to side)

- 0 ☐ Normal
- 1 ☐ Mild to moderate decrease in sensation
- 2 ☐ Severe to total sensory loss

Best Language (Describe picture, name items, read sentence)

- | |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 <input type="checkbox"/> No aphasia
1 <input type="checkbox"/> Mild to moderate aphasia
2 <input type="checkbox"/> Severe aphasia
3 <input type="checkbox"/> Mute |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

9. Dysarthria (Read several words)

- | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 <input type="checkbox"/> Normal articulation
1 <input type="checkbox"/> Mild to moderate slurring of words
2 <input type="checkbox"/> Near unintelligible or unable to speak
9 <input type="checkbox"/> Intubated or other physical barrier |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

10. Extinction and inattention

- | |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 0 <input type="checkbox"/> Normal
1 <input type="checkbox"/> Inattention or extinction to bilateral simultaneous stimulation in one of the sensory modalities
2 <input type="checkbox"/> Severe hemi-inattention to more than one modality |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

TOTAL NIHSS SCORE: _____

The above is a modified version of the NIHSS that is used at Constantiaberg Medi-Clinic. The initial score is collected by a nurse (who has been employed for that reason). This score is kept in the patient's records for further comparison later in the progress of the patient's rehabilitation³⁵.

The NIHSS is used as a preference of Dr Gardiner, the neurologist who was one of the doctors instrumental in developing the Stroke Service and is the current chairperson of the monthly meetings.

ABCD² SCORE³⁶:

ABCD² SCORE FOR PREDICTING TIA PROGNOSIS:

AGE	≥ 60 Years	1 point
BLOOD PRESSURE	≥ 140 / 90mmHg	1 point
CLINICAL FEATURES	Unilateral weakness	2 points
	Speech problems	1 point
DURATION OF ATTACK	≥ 60 minutes	2 points
	10 – 59 minutes	1 point
DIABETES		1 point

Interpretation of the scores:

SCORE 1 – 3 (LOW)	2 day risk	1.0%
	7 day risk	1.2%
SCORE 4 – 5 (MODERATE)	2 day risk	4.1 %
	7 day risk	5.9%
SCORE 6 – 7 (HIGH)	2 day risk	8.1%
	7 day risk	11.7%

The risk described here is that of a full blown stroke developing at either 2 or 7 days following the initial TIA.

As can be seen, the higher the score, the greater the risk for developing stroke.

CHAPTER FIVE: DISCUSSION:

- **HISTORICAL BACKGROUND**
- **THE LOCAL MODEL**
- **COMPARISON WITH SERVICES IN AUSTRALIA, USA AND UK**
- **THE SOUTH AFRICAN CONTEXT**

University of Cape Town

HISTORICAL BACKGROUND:

Constantiaberg Medi-Clinic is a 238 bed private hospital situated in the southern suburbs of the Cape Town Metropolitan area. It hosts wards for paediatrics, general medicine and oncology, surgery, orthopaedics, as well as a critical care unit, and a high care unit. It also has an Obstetric section with labour ward and neonatal intensive care unit.

There are a number of specialized services: a Joint Replacement Unit, a world renowned Haematology department incorporating a Bone Marrow Transplant Unit, as well as the Stroke Service.

The Stroke Service at Constantiaberg Medi-Clinic was started in late 2001 / early 2002 by Dr. Pete Malan, a former Head of the Emergency Centre in conjunction with Dr John Gardiner, a specialist neurologist.

It was implemented with monthly meetings held to explore various issues surrounding the management of CVA cases admitted to the hospital.

During this early phase, most of the interest was focussed around the development of various aspects of emergency management. These laid emphasis on the timing of imaging with subsequent administration of Alteplase (Actilyse®), laboratory and bedside testing.

Thereafter the idea was mooted to collect data on these patients. This included a time frame of the clinical pattern, treatment given, scans done and ancillary staff involvement. A clinical proforma was then developed for this purpose and with the need to develop a database from the information gleaned on the proforma. (See: **Acute Stroke Proforma:** page 81). This proforma has been modified as different needs have been identified for inclusion in the database.

Over the years the roles of the different health care professionals have become more structured with the ongoing involvement of the multidisciplinary team which is integral to the care of stroke patients, the development and implementation of protocols and the clarity of the roles played by the various ancillary support groups.

But the unit is still dynamic as representatives from different disciplines are identified as being vital to the group and are invited to provide assistance. However the

direction of growth remains on providing the best evidence based care in the acute phase.

THE LOCAL MODEL:

PRE-HOSPITAL INVOLVEMENT:

The family doctors (or general practitioners)

They play an important role in providing education and information about the service to their practice community.

A concerted effort has been made (and remains in place) to improve their skills in identifying CVA cases and then leading to the appropriate referral of these to the stroke service (at the centre or directly to the specialists).

They are also gradually adapting to the idea of the importance of the time factor in getting stroke victims to the centre as soon as possible. Many FP's are now informing the centre of the imminent arrival of these patients. Sometimes they contact the specialists directly and this expedites the booking of the scans that may be required.

An important feature is the early and appropriate referral from the family doctors of patients with Transient Ischaemic Attacks (TIA's). They are aware as to when these can be referred to the neurologist or the vascular surgeon (in the case of carotid artery pathology).

The FP's liaise with the families and caregivers in the rehabilitation phase, providing psychological and social support as well as medical care when stroke survivors are discharged back into the community.

The Emergency Medical Services (EMS):

There are a number of ambulance providers involved in the transfer of cases to Constantiaberg Medi-Clinic. (ER24, Netcare 911, MeloMed and Metro to name but a few.)

A number of the EMS personnel who bring patients to the centre, are not aware of the stroke unit that is offered there.

The call centres that control the flow of patients need to be informed and educated of the importance of directing the stroke victims to the specialised service. This is vital even though there may be medical aid restrictions or that the emergency centre may not be the closest available facility.

The importance of the time factor is still something that needs to be properly addressed within the EMS fraternity.

Client Service (Public Relations) and Network Marketing Managers:

The role of these individuals is focussed mainly on informing the other medical disciplines as well as the public of the stroke service.

To this end they utilise various means of telecommunications media to reach and educate the community at large.

ACUTE EMERGENCY CARE:

Time is of the essence when dealing with patients suffering from stroke.

It is imperative that all the staff working in the emergency centre be fully aware of the clinical guidelines developed to assist the medical practitioners to safely, quickly and adequately manage cases presenting there, with any suggestion of impaired neurological deficit. (See attached protocol guidelines for the management of cerebrovascular accidents and transient ischaemic attacks as described in the earlier chapter).

The Medi-Clinic Private Hospital Group has implemented the use of a system for managing patient flow as recommended by the South African Triage system.

Any patient presenting with some form of neurological impairment or altered level of consciousness is automatically coded as **ORANGE** and has to be attended to within five minutes of arrival.

However the individual requirements of the centre determine that these persons should be attended to immediately.

The time frame of onset of symptoms is of paramount importance and the early care of these cases should focus on that by managing them urgently, quickly and thoroughly.

The aim is to determine the following:

CLINICAL EVIDENCE	ACTION PLAN
Any neurological deficit?	Full evaluation
Is this a CVA?	Urgent CT or MRI scan
Is this an Ischaemic event?	Thrombolysis
The presence of haemorrhage?	MRA scan and neurosurgical referral

The management of stroke patients follows the route of relevant history, clinical examination, bedside tests, initial treatment, specialised investigations and drug therapy.

The clinical history:

This should highlight the details of the actual neurological deficit as noted by the patient and/ or the family or witnesses who are present.

It includes:

- The time of onset of symptoms,
- The degree of motor or obvious sensory impairment,
- Any speech problems,
- Any swallowing difficulties,
- A change in the level of consciousness,
- Confusion,
- Any associated symptom like seizures.

It is also vital to obtain ascertain whether there has been any change in the symptoms from the time of onset till presentation at the emergency centre.

One point of conflict is to determine when the impairment started while the patient was asleep. The commencement of symptoms is then taken to be when the patient went to bed the previous night. If there is witnessed patient activity during the night, this could be used as an alternative time frame.

The functional capacity of the patient prior to the CVA is vital for determining the degree of impairment that has occurred. The following questions should be asked:

- What have been the activities of daily living?
- What degree of independence did the patient enjoy?
- What was the intellectual level prior to the stroke?

The modified Rankin scale (see attached table: page 56) can be scored here and then re-assessed throughout the patient's rehabilitation phase.

The mental capacity of the patient will help in the decision making on the intensity and depth of any rehabilitation plans.

Background medical history should identify any major risk factors (diabetes mellitus, hypertension, hypercholesterolaemias, any vascular diseases and smoking or alcohol details). Any significant family medical history is also vital. Current medications should be noted.

Any history of previous TIA's with relevant investigations and treatment should be elicited.

If the administration of thrombolytics is considered, then knowledge of any recent surgery or significant head trauma is essential.

If arrival by ambulance, the escorting crew should indicate the condition of the patient at first point of contact, their first clinical observations and vital signs and any change on physical status on route. Any interventions and minor investigations are noted as these form part of the continuous evaluation of the patient in the critical first 24 - 48 hours.

Focussed Neurological Assessment:

All findings with any alterations should be accurately recorded and the time frame carefully noted.

Examination of the nervous system should form the central core in assessing the status of the stroke victim.

The following neurological signs should be highlighted:

- Side of body affected.
- Limb Weakness.
- Grade of weakness.
- Gait.
- Cerebellar Functions.
- Sensory fallout.
- Cranial nerve examination.
- Fundoscopy.
- Presence of Nystagmus.
- Visual Field testing.
- Cognitive Functions.

The vital observations are recorded and the deviations are treated appropriately:

- **The pulse:** the rhythm, rate and volume recorded. Atrial Fibrillation should be actively looked for. Auscultation of the carotid arteries is essential to determine the presence of any bruits. Blood vessel wall hardening should be evaluated for evidence of atherosclerosis.
- **The blood pressure:** severely elevated systolic (≥ 160 mmHg) and diastolic readings (≥ 100 mmHg) are treated in the initial management phase.
- **Temperature** ($>38^{\circ}\text{C}$):
- **Respiratory rate** (< 12 or > 30 breaths per minutes):
- **O₂ saturation** ($< 92\%$):

Evaluation of any form of vascular disease, the level of consciousness and the presence of neck stiffness should be done.

During the examination, emphasis is made on completing the NIHSS score (see page 58 - 60) and using this as a baseline to track the progress of the patient through the acute phase and into the long term care.

The ABCD² tool (see page 61) can be used as part of the examination in case where the diagnosis of a TIA is considered.

Bedside Testing:

- Haemoglucotest: Hypoglycaemia can be quickly treated.
- Haemoglobin:
- Urinalysis: Any abnormality detected here should be followed by a formal Microscopy, Culture and Sensitivity test done through the laboratory.
- Electrocardiogram: Done routinely, in an attempt to seek any vascular damage or arrhythmias. Any recordings of old ECG's will be helpful for comparison.

Initial Management

This is mainly supportive and dependent on the patient's condition on arrival at the emergency centre. Oxygen is administered via face mask. Intravenous access is obtained via a peripheral line. Urgent immediate management is initiated for

variations in glucose levels, pyrexial illnesses, seizures and dehydration if these are present.

Formal Laboratory testing: The following tests are recommended and are done based on the patient's background medical history:

- Full Blood Count with Haemoglobin, white cell and platelet count.
- Prothrombin time and partial prothrombin time.
- Blood glucose confirmation.
- Renal function test.
- Liver function test.
- C-Reactive Protein.
- INR of the patient is on Warfarin.
- Arterial Blood gases.
- Lumbar Puncture (in the presence of neck stiffness and pyrexia and if meningitis is suspected).

Radiological imaging:

There are a number of reasons for the urgency of scanning in the acute phase of a CVA.

The distinction needs to be made between an ischaemic and a haemorrhagic stroke as the treatment pathways differ widely as noted in the earlier chapter.

The possibility of administering thrombolytic agents is a reality if the diagnosis of an ischaemic infarct can be made within the recommended three to four hour time frame.

The extent of the brain damage can help to determine the prognosis and further management of the patient.

- **CT Scanning:** This can be done easier at all times mainly to exclude the presence of blood within the cranium and is usually performed at night and over the weekends when there is no radiologist on duty. Most of the CT scans done are non-contrasted.
- **MRI Scanning:** This is more sensitive in determining subtle brain infarcts. They are commonly done during office hours when the radiologists are on duty for definitive reporting.
The comparison between the two forms of scanning can be noted in the table below.

- **MRA Angiography:** This type of scan is done in the presence of SAH to identify the possible site of berry aneurysms. If these are present, an evaluation is done as to whether they are amenable to invasive surgery.

COMPARISON BETWEEN CT SCANS AND MRI SCANS IN STROKE:

Type of Stroke	CT Scan (no contrast)		MRI Scan	
	Sensitivity	Specificity	Sensitivity	Specificity
Ischaemic	16%	96%	83%	98%
Haemorrhagic	89%	100%	81%	100%
MRI Scans are more sensitive than CT Scans in detecting Chronic Haemorrhage				

INITIAL THERAPY:

This depends largely on the presenting features and should involve the management of pyrexia, dehydration, vomiting and nausea.

Further drug treatment depends on the presence or absence of cerebral bleeding.

Ischaemic Stroke:

This is assumed in the absence of blood on radiological imaging. If the presentation is within the 3 – 4 ½ hour time frame, the decision is made by the referral doctor as regards to the administration of thrombolytics, provided there are no contra-indications. Alteplase (tPA) is usually the treatment of choice. This is given in the emergency centre where the patient is constantly monitored and further observed for another 40 minutes to one hour in the emergency centre, after which transfer to a general medical ward is arranged. See diagram: **APPROACH TO ISCHAEMIC STROKE** (page 82).

If the case is seen after the three to four hour cut off period, definitive care continues in the medical ward.

If the patient starts to show signs of clinical improvement, the diagnosis of a possible TIA is assumed and a different care pathway is then followed.

Haemorrhagic Stroke:

If there is any evidence of intra-cranial bleeding the differentiation between SAH and an intra-cerebral bleed has to be made.

If an intra-cranial bleed is present, the extent of the bleed and brain tissue damage is determined. This, together with the clinical condition of the patient, is responsible for further management.

In the presence of SAH, a MRA is done to check for the site of a possible berry aneurysm in the Circle of Willis. If present, the patient is referred to the neurosurgeons at Groote Schuur Hospital for surgical intervention.

The administration of Activated Factor VII (NovoSeven ® or Recombinant Factor VIIa)³⁷ has been mentioned as a possible therapeutic means in patients with cerebral bleeds but no suitable case has been identified and the drug has thus not be used. See diagram: **APPROACH TO HAEMORRHAGIC STROKE**. (see page 83).

Transient Ischaemic Attacks:

A pathway for evaluating these cases has been developed and is in the process of being implemented. See diagram: **APPROACH TO TRANSIENT ISCHAEMIC ATTACK** (see page 84).

In the more severe cases that largely mimic stroke, the patients are admitted at least overnight or for 24 hours. Medical therapy is the mainstay here and the choice of drugs during the hospital phase is user-dependent as described below:

DESCRIPTION OF DRUGS USED IN STROKE CASES:

ANTIPLATELET DRUGS	ANTI-COAGULATION DRUGS	ANTI-THROMBOTIC AGENTS
Aspirin	Warfarin	Alteplase (Actilyse®)
Clopidogrel (Plavix®)	Heparin	
Dipyridamole (Persantin®)	Enoxaparin (Clexane ®)	
	Dalteparin (Fragmin®)	

The decision to request an urgent CT or MRI scan in these cases is also variable. However in most instances specialised imaging is done on semi-urgent basis on all patients admitted to the hospital.

The patients that show features of rapidly resolving signs are usually discharged from the emergency centre with one of the drugs mentioned above and will have their scans done as a routine investigation within a week. In some patients a Carotid Doppler Ultrasonographic examination may be indicated. The team of vascular surgeons is contacted if any abnormality is noted on ultrasound.

ACUTE NURSING CARE:

The emergency centre nurses are usually the first members of this service involved in the care of the stroke victims.

They are responsible for the initial clinical management, providing emotional support to both the patient and their families and enrolling the assistance of the hospital counsellor here.

The data collection on various clinical aspects is also commenced here: the modified Rankin score, the NIHSS score, and the ABCD² score. One of the nurses has been especially appointed by the hospital to collate the data for the stroke service, which is then forwarded to the data capturers at Medi-Clinic Head Office for the inclusion into a database that has been specially developed for the stroke service: the preliminary results of which has been included in Chapter Six.

The focussed nursing input continues in the general ward as it slowly evolves from acute to rehabilitative treatment and prevention of complications. The ward staff are responsible for basic patient care, pressure care, and assistance with the physiotherapists, occupational therapists and speech therapists in mobilising the patients.

SECOND PHASE CARE:

The specialists are involved fairly early in the management of the patient. As the doctor responsible for the long term care and follow-up of the patient, it stands to reason that s/he will be the person determining all aspects of treatment, including the scan of preference, whether and which thrombolytics will be administered, discussion with the patient and / or family on the possible prognosis, further decisions on management and the form of the rehabilitation that will best suit the case.

THE PARA-MEDICAL PROFESSIONALS:

Their involvement usually commences on the day after admission and continues in some cases for up to eighteen months.

A full discussion of their roles and responsibilities lies outside the scope of this paper. Needless to say, they are an absolutely integral part of the service, and are central to the rehabilitation of the stroke patients.

THE SUPPORT GROUP:

This structure evolved from a meeting started by some survivors and family members under the guidance of the psychologist. It has grown and consolidated to such an extent that it has become an independent entity requiring minimal outside input.

COMPARISON WITH SERVICES IN AUSTRALIA, USA AND UK:

The unit at Constantiaberg Medi-Clinic compares favourably to the composite model described on page 42 in Chapter Three of this dissertation.

WHAT HAPPENS AT CONSTANTIABERG MEDI-CLINIC:

The emergency centre has been designated as the preferred area within the hospital to effectively and quickly manage these patients. They are treated in the resuscitation room which has been equipped to the level of a critical care unit and can deliver appropriate therapy to the acute stroke victims.

The dedicated multi-disciplinary team comprises the emergency centre doctors and nursing staff, the specialists (neurologist or physician) and the allied para-medical health professionals.

The protocols that have been developed for the stroke centre have been described in the earlier chapter. The neurologist also dedicates time with the younger emergency centre doctors enlightening them on the process of treating these patients, thereby cementing the value of the protocols.

The stroke service meets monthly. All team members present feedback on the events relevant to their disciplines from the previous meeting and then provide information on the proposed plans for the next month. The clinical departments also highlight any problems that they may have encountered. The specialists use this meeting as a platform to present any interesting and unusual scans from patients seen between the meetings. They (the specialists) also take the opportunity to discuss and circulate any topical recent articles from the literature.

Support in different forms is given to both the patients and their families. The doctors are responsible for assisting the victims and / or families in making important decisions regarding the further care. But during the long rehabilitative phase, emotional support is rendered by the nurses, hospital counsellor and the physiotherapists. The stroke support group is starting to play an important role in liaising with other victims and families.

The care offered by the physiotherapists and the speech therapists starts early in the rehabilitative phase. In some cases this can happen the day after the event but can be delayed dependent on the patient's clinical condition and type and site of the CVA. Rehabilitation continues through to when the patient is discharged either to a

specialised rehabilitation centre for stroke victims or to the home environment. In the former the management is given via the resident physiotherapists at the centre. With the latter, the patient is required to return to the physiotherapy practice on an outpatient basis.

ADVANCED MODEL

Even though most of the treatment of the stroke victim is offered within the emergency centre, the critical care and high care facilities are available if so needed.

The patients do have immediate access to both CT and MRI scanning at all hours. The implementation of a web-based X-ray system has meant that the scans of the patients can be reviewed by the radiologists at any time which is an added advantage for those presenting outside working hours.

Similarly Carotid Doppler Sonography is readily available albeit not at all hours. This can be done either through the radiological department or directly via the vascular surgical practice present at the hospital. The advantage of the latter is that carotid endarterectomies can be scheduled in a quicker, more streamlined manner.

The protocols focussing on the management of patients with TIA's have also presented in the earlier chapter.

COMPARISONS WITH INDIVIDUAL COUNTRIES.

The outlines of stroke care in the other areas have been described in Chapter Three of this dissertation. See Table: **COMPARISON TABLE** (See page 85).

Australia

The model at Constantiaberg follows the basic one described by the Stroke Foundation of Australia; the only difference being the recommendation there that weekly team meetings are held and here there are monthly meetings.

When looking at the advanced model in Australia, the stroke service here lacks the full input given by the neurosurgical team. The invasive procedures for the treatment of aneurismal conditions causing SAH are best provided at Groote Schuur Hospital where all the patients with that problem are transferred.

As Constantiaberg Medi-Clinic is a private institute, research is not a primary focus here. But there are individual doctors who are invited to assist with international trials. At present there are no other stroke related projects at the hospital.

There is no rapid TIA assessment clinics based at the hospital. The individual specialists have their own method of doing this.

United States of America

Looking at the indicators released by the American Heart Association, the local model compares quite favourably. The one factor that could be lacking is the community resources available for re-integration back into society. But the work done by the stroke support group could be the key to resolving that problem.

The mission statement from the PCNSR indicates that there should be an effort to reduce the disparities between the different populations groups. This will be somewhat of a problem given that Constantiaberg Medi-Clinic is a private hospital serving mainly the population group that can afford the medical care offered there.

United Kingdom

The acute stroke service requirements recommended in the United Kingdom is not as detailed as the model developed here. The UK version does not mention the utilisation of specialised radiological imaging. It also alludes to access to physiotherapists, speech therapists and dieticians but does not fully describe the level of post-acute care that will be necessary.

THE SOUTH AFRICAN CONTEXT:

The Department of Health has published a guideline outlining the principles recommended in the management of stroke victims in South Africa. This is outlined in the following table.

Section 7.4 of the above-mentioned guideline pertains to the recommended standards for management of stroke patients. Examination of these with comparison to what has been described locally indicates that our service has accommodated the National Guidelines as well.

A South African Medical Journal publication entitled "Stroke Therapy Clinical Guideline"⁹ provides a more scientific explanation on the management of stroke. Section 10 of this article describes the expected composition of the stroke unit.

The highlighted features of these two publications have been amalgamated. The Constantiaberg model is then paralleled to this to look at similarities..

When examining this table (page 80), it is apparent that our model described far exceeds the minimum recommendations given by the Department of Health.

COMPARISON BETWEEN SOUTH AFRICAN RECOMMENDATIONS AND THE LOCAL MODEL:

RECOMMENDATIONS	LOCAL MODEL
1. An accurate diagnosis made	This is done in the EC
2. Rights of access to treatment	
3. Emergency Management available	
4. Information of risk factors	Usually done by the FP's
5. Availability of rehabilitation services	Part of the stroke service
6. Centre with a CT scan and /or neurosurgeon	Present.
7. Stroke protocol guidelines	Guidelines are in place
8. Stroke programme resources	Present.
9. Prevention of secondary stroke	Implementation of TIA protocol
10. Multi-disciplinary management team	Yes.
11. Long – term follow up	Done via the physiotherapists.
12. Activities of Daily living.	Done via the physiotherapists

Constantiaberg Medi-Clinic

Acute Stroke Proforma

Patient Initials: Hospital Number

Gender: Date of Birth:

Attending Specialist:

Date and Time of Onset of Symptoms (If known):

Date and Time of Admittance to Hospital:

Date and Time of CT / MRI:

CT / MRI Result: Ischaemic ☐ Haemorrhagic ☐

Was Thrombolytic Therapy Used? Yes ☐ No ☐ N/A ☐

Physiotherapist: Yes ☐ No ☐

Occupational Therapist: Yes ☐ No ☐

Social Worker: Yes ☐ No ☐

Speech Therapist Yes ☐ No ☐

Clinical Psychologist Yes ☐ No ☐

Is this the patient's first CVA? Yes ☐ No ☐

If No, how many previous CVA's?:

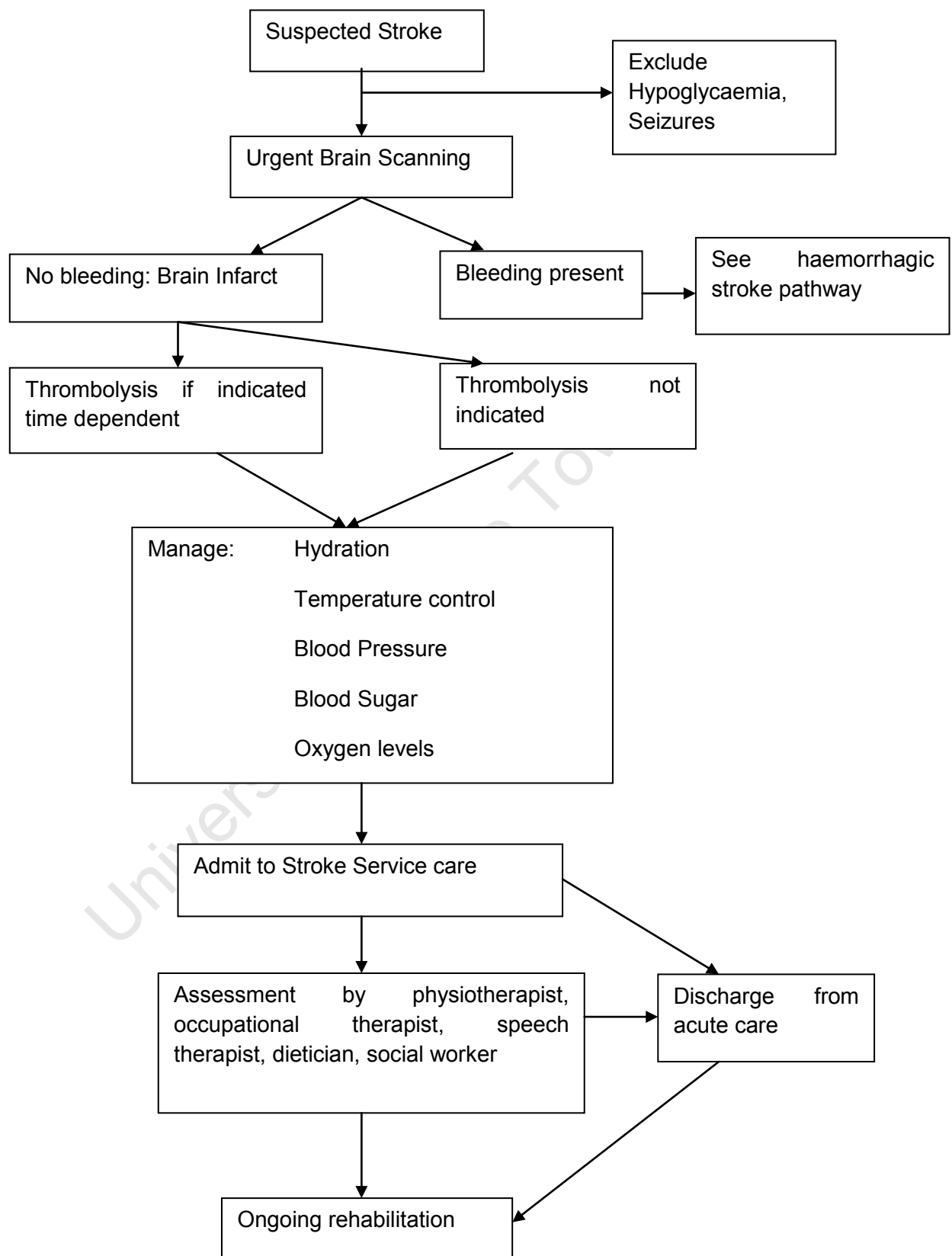
Diagnosis (ICD No.):

Date and Time of Discharge / Transfer:

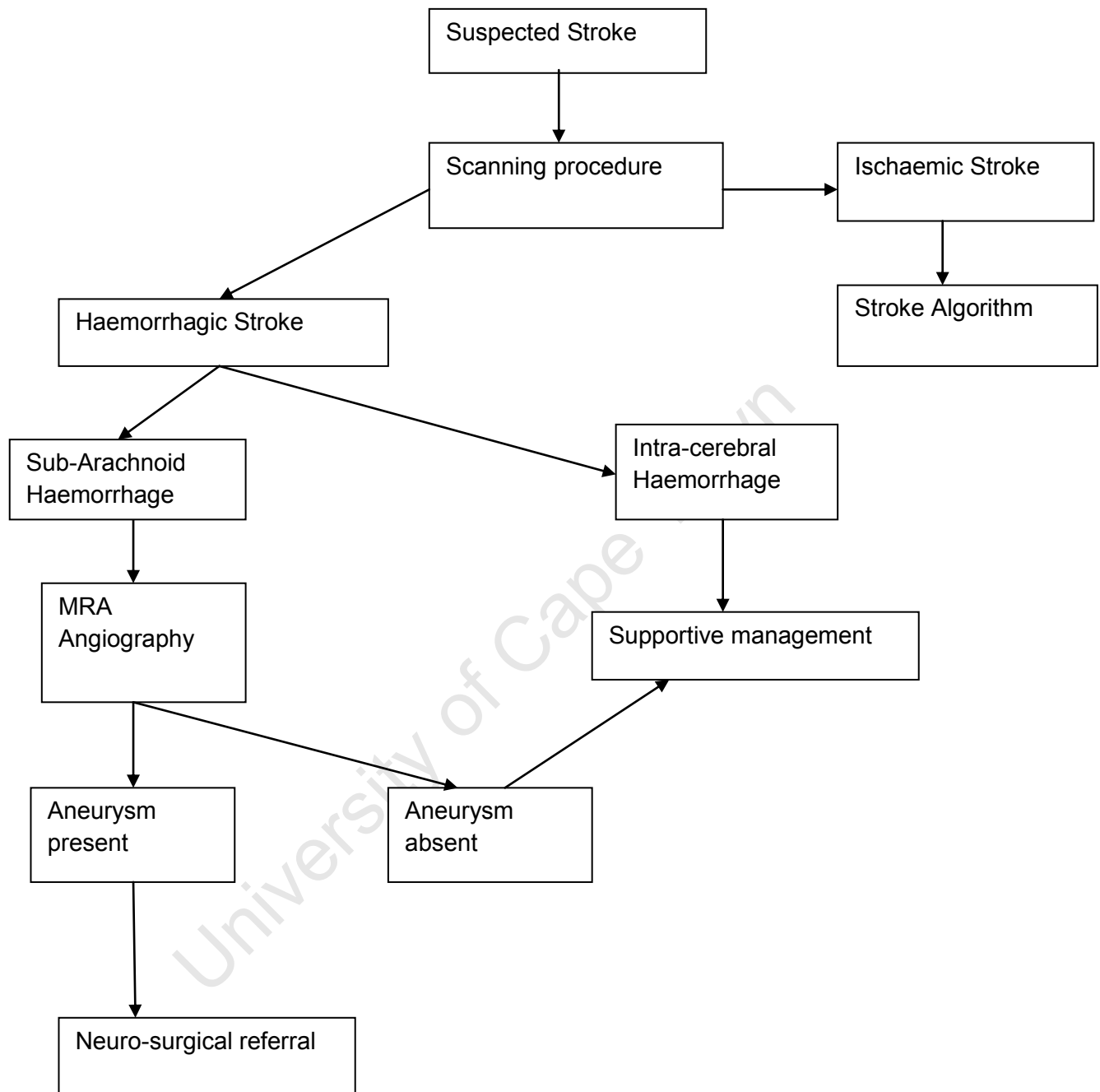
Patient Discharged /Transferred to:

Date and Time of Death (if Applicable):

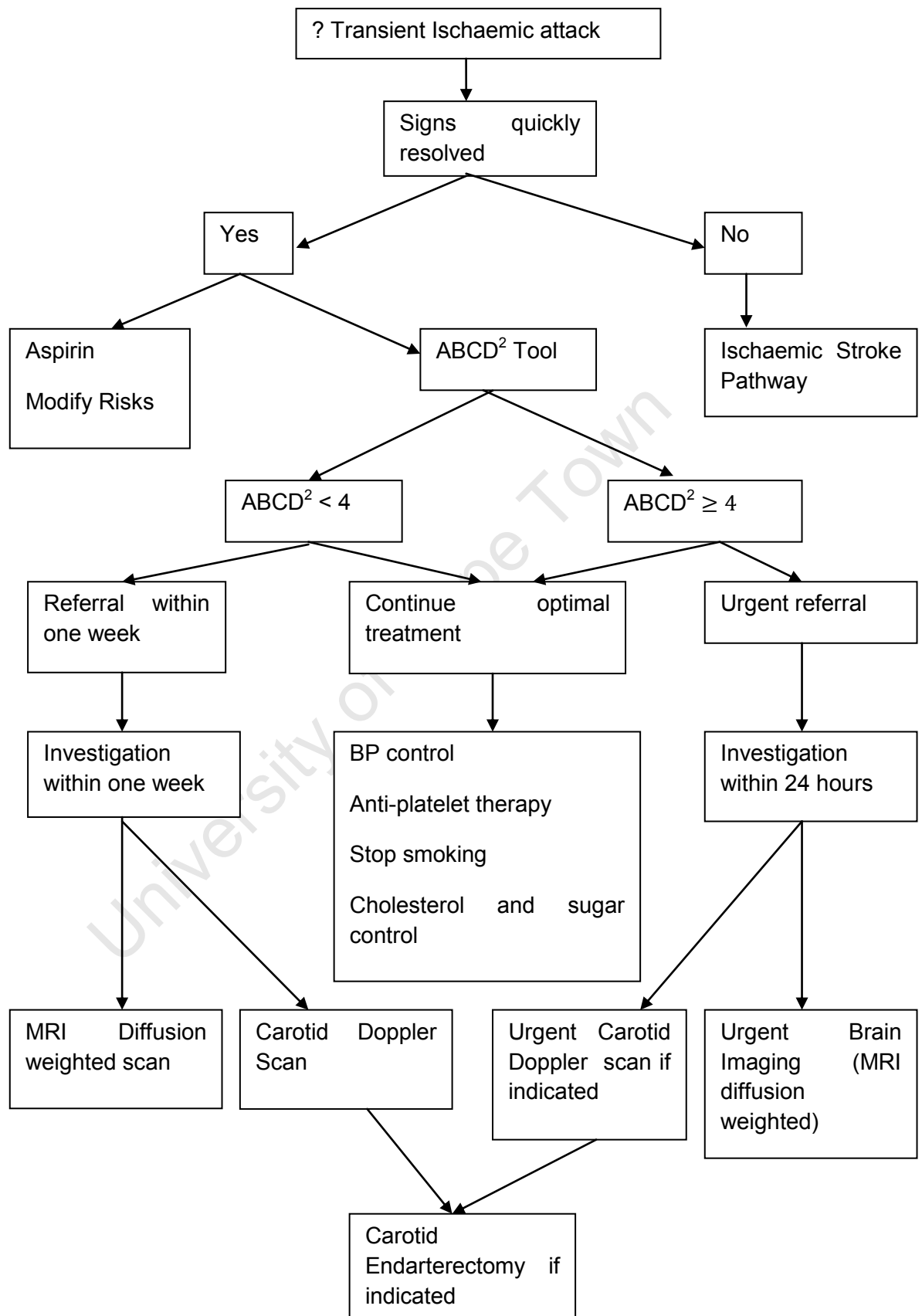
AN APPROACH TO ISCHAEMIC STROKE:



AN APPROACH TO HAEMORRHAGIC STROKE:



APPROACH TO TRANSIENT ISCHAEMIC ATTACKS



COMPARISON BETWEEN STROKE MODELS:

FEATURE	AUSTRALIA	UNITED STATES	UNITED KINGDOM	LOCAL
Dedicated area within the hospital to manage stroke victims.	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Dedicated multi-disciplinary team with members having a special interest in stroke and its rehabilitation	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Standardised Protocols in place for the management of Strokes and Transient Ischaemic Attacks.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Regular meetings by the multi-disciplinary team to discuss patient care and related topics.	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Support given to carers of stroke victims during the rehabilitation process.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Early acute intervention and onset of rehabilitation that continues for an extended period of time.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Onsite intensive and / or high care units with the focus on managing acute stroke victims.	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Rapid access to onsite radiological imagery in the form of Computerised Tomography and Magnetic Resonance Imaging. Access to Carotid Doppler Sonography.	<input checked="" type="checkbox"/>			<input checked="" type="checkbox"/>
Capacity for intensive monitoring of the stroke victims during the critical first 48 hours	<input checked="" type="checkbox"/>		<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Standardised protocols for managing and assessing patients who have presented with Transient Ischaemic Attacks.	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>

CHAPTER SIX: REVIEW OF DATA

- **DEVELOPMENT OF THE DATABASE**
- **ANALYSIS OF THE DATA**

University of Cape Town

DEVELOPMENT OF THE DATABASE

The plan to develop a database was mooted early in the formation of the Stroke Service. The fields for inclusion in this project were determined mainly by Dr Gardiner with input from the other doctors within the service. Once the different parameters had been determined, Constantiaberg Medi-Clinic was responsible for the electronic database development. Data had been collected over the past 5 – 6 years but it has only been in the last 3 years that it has been incorporated into the database.

A registered nurse from the Emergency Centre was identified to be responsible for collecting and collating the data of all the stroke patients admitted via the emergency centre into the wards or the intensive care unit. This nurse would enter all the relevant records from the emergency centre and then do the follow up notations when the patients were in the wards. The latter was done in conjunction with Dr Gardiner.

No formal documentation was recorded of the patients' condition once they were discharged. Informal discussion from the physiotherapists and occupational therapists would occur during the monthly meetings on the progress of some of the patients but nothing had been formally noted. The database thus only includes details from the in-hospital stay of the individual patients.

The database development is ongoing and dynamic. The Acute Clinical proforma document that was initially used has been considerably expanded and a separate form for TIA's has now also evolved.

The main elements of the CVA system incorporate the following:

Name; Hospital Folder Number; ID numbers; Sex; Race; Age; Date of admission; Time of onset of stroke, time of doctor seeing the patient, time to Scanning, Physiotherapy, Occupational therapy and Speech Therapy. Pre-existing co-morbidities, mRS on admission, NHISS on admission; type of radiological scan done; thrombolysis or surgical intervention; time of the intervention if done; TOAST classification; diagnosis; first follow-up mRS and NHISS done on day 5 or discharge, follow-up scan done, second follow-up mRS and NHISS done on day 10 – 15 or on discharge; discharge details; date of discharge, attending doctor.

The TIA form encompasses the following fields:

Name; Hospital Folder Number; ID numbers; Sex; Race; Age; Date of admission; Time of onset of TIA, time of doctor seeing the patient, time to Scanning, Physiotherapy, Occupational therapy and Speech Therapy. Pre-existing co-morbidities, time of resolution of the TIA, discharge details, discharge date, attending doctor.

For this dissertation, the patients entered into this database between March 2008 and October 2010 have been included and their details have been analysed.

A number of factors have been identified from the database for more detailed discussion. The figures have been entered in tabular form and a brief discussion on that factor follows.

Brief mention is made on the age, sex, race, final diagnosis and radiological findings of the patients. There is a larger focus on the cases of CVA as the numbers in this group are larger than for TIA's.

More detailed discussion with comparison to international data will be done on the cases given thrombolytic agents and the pre-existing co-morbidities related to stroke.

ANALYSIS OF THE DATA:

OVERALL DESCRIPTION:

TOTAL CASES IN TIME PERIOD	158	
CEREBROVASCULAR ACCIDENTS	135	85.44%
TRANSIENT ISCHAEMIC ATTACKS	23	14.56%

A total of **158 cases** have been entered on the database for the time period considered; of which **135 (85,44%)** were **CVA's** and **23 (14.56%)** were **TIA's**.

What should be taken into consideration here is not all the cases of TIA's had been admitted. Most of them were seen, assessed and discharged from the EC and follow-up was requested with either their FP or one of the specialists involved in the stroke service. As such, these details have not been entered onto the database which includes only the cases that have been admitted to the medical wards or ICU. Furthermore only the cases admitted under the care of a neurologist /physician have been submitted. So these figures are slightly skewed into appearing that there is a higher proportion of CVA's cases as compared to TIA's.

SEX DIFFERENTIATION:

	MALES		FEMALES	
OVERALL	109	68.99%	49	31.01%
CVA's	92	68.15%	43	31.85%
TIA's	17	73.91%	6	26.09%

Overall **68.99%** of the cases were males and **31.01%** were females.

Analysis of the CVA database shows that **92** cases were male patients and **43** cases were female. (This relates to **68.15%** and **31.85%** respectively).

The TIA database showed **17** males and **6** females (**73.91%** and **26.09%** respectively).

RACE DIFFERENTIATION:

	CVA'S		TIA'S	
WHITES	103	76.30%	19	82.61%
COLOUREDS	30	22.22%	4	17.39%
BLACKS	2	1.48%	0	0%
ASIANS	0	0%	0	0%

This differentiation will be distorted for a number of reasons:

1. The geographical setting of the hospital: this is in an area where there are predominantly white citizens, hence the preponderance of whites in the group.
2. There are significantly more whites either on medical aid or who have the means to pay for private medical costs.
3. This table is only depicted here as a matter of completeness of discussion.

A further breakdown of the figures combining the statistics from sex and race indicates the following trends:

	CVA'S		TIA'S	
WHITES	103	76.30%	19	82.61%
MALES	68		14	
FEMALES	35		5	
COLOUREDS	30	22.22%	4	17.39%
MALES	22		3	
FEMALES	8		1	
BLACKS	2	1.48%	0	0%
MALES	2		0	
FEMALES	0		0	
ASIANS	0	0%	0	0%
MALES	0		0	
FEMALES	0		0	

AGE DISCUSSION:

CEREBROVASCULAR ACCIDENTS	OVERALL AVERAGE	70.96 YEARS
	MALES	FEMALES
AVERAGE AGE	69.09	74.95
MAXIMUM AGE	93	95
MINIMUM AGE	31	18
MEDIAN	71	76

TRANSIENT ISCHAEMIC ATTACKS	OVERALL AVERAGE AGE	73.04
	MALES	FEMALES
AVERAGE AGE	73.76	71.00
MINIMUM AGE	51	52
MAXIMUM AGE	86	82
MEDIAN	74	75.5

The average age of all the CVA cases is **70.96** years.

Looking at this in more detail: for male patients, the average age is **69.09** years and for females **74.95** years.

In the table for TIA's the average age overall is **73.04** years; and for males is **73.76** and for females is **71.00** years.

CO-MORBIDITIES:

The co-morbidities examined are detailed as below:

CEREBROVASCULAR ACCIDENTS:

CO-MORBIDITIES	OVERALL		MALES		FEMALES	
	ACTUAL	%	ACTUAL	%	ACTUAL	%
Atrial Fibrillation	31	22.96%	20	21.74 %	11	25.58%
Hypertension	94	69.63%	64	69.50 %	30	69.77%
Diabetes	36	26.67%	24	26.09 %	12	27.91%
Smoking	14	10.37%	12	13.04 %	2	4.65%
Dyslipidaemia	37	27.41%	30	32.61 %	7	16.28%
Family History of Vascular Disease	4	2.96%	2	2.17 %	2	4.65%
Thrombophilia	0	0%	0	0%	0	0%
Metabolic Syndrome	0	0%	0	0%	0	0%
Carotid Artery Syndrome	1	0.74%	1	1.09 %	0	0%
Aortic Disease	0	0%	0	0%	0	0%
Valvular Disease	0	0%	0	0%	0	0%
Patent Foramen Ovale	0	0%	0	0%	0	0%
Previous CVA	17	12.59%	12	13.04 %	5	11.35%
No Co-morbidity	17	12.59%	11	11.96 %	6	13.95%
More than one Co-morbidity	74	54.81%	53	57.61 %	21	48.4%

Undoubtedly Hypertension and Diabetes account for the greatest proportion of co-morbidities in cases who present with cerebrovascular disease. Hypertension is by far the greatest protagonist with almost **70%** of patients, followed by Diabetes at **26,27%**. What is also interesting is the numbers of cases with 2 or more co-morbidities: **54%**.

TRANSIENT ISCHAEMIC ATTACKS:

CO-MORBIDITIES	OVERALL		MALES		FEMALES	
	ACTUAL	%	ACTUAL	%	ACTUAL	%
Atrial Fibrillation	4	17.39 %	4	23.53 %	0	0%
Hypertension	19	82.61 %	14	82.35 %	5	83.33%
Diabetes	4	17.39 %	4	23.35 %	0	0%
Smoking	1	4.35%	1	5.88%	0	0%
Dyslipidaemia	7	30.43 %	6	35.29 %	1	16.67%
Family History of Vascular Disease	0	0%	0	0%	0	0%
Thrombophilia	0	0%	0	0%	0	0%
Metabolic Syndrome	0	0%	0	0%	0	0%
Carotid Artery Syndrome	0	0%	0	0%	0	0%
Aortic Disease	0	0%	0	0%	0	0%
Valvular Disease	1	4.35%	1	5.88%	0	0%
Patent Foramen Ovale	0	0%	0	0%	0	0%
Previous CVA	0	0%	0	0%	0	0%
No Co-morbidity	1	4.35%	0	0%	1	16.67%
More than one Co-morbidity	10	43.48 %	9	52.94 %	1	16.67%

A similar pattern exists in patients who present with TIA's. >80% of patients have associated Hypertension. There is a smaller proportion of cases with associated Diabetes.

Examination of the INTERSTROKE study for risk factors⁴⁰, notes that there are ten risk factors linked to 90% of stroke cases. The 10 are: history of Hypertension; current smoking; waist-to-hip ratio; diet risk score; regular physical activity; diabetes mellitus; alcohol intake; psychosocial stress and depression; cardiac causes; and derangement of lipoproteins. We have only included five of these in our list of risk factors for inclusion on the database.

Looking at the literature regarding the risk factors for CVA, these can be divided into non-modifiable and modifiable causes^{39, 40}.

NON-MODIFIABLE RISK FACTORS:

These are also called risk markers. These are indicators that cannot be changed but instead are used as identifiers of those persons greatest at risk for developing stroke.

They include age, sex, race and ethnicity.

Of these, age is the most important risk factor: the older the person the greater the risk of stroke. It is estimated that the incidence of stroke doubles in each successive decade at an equal rate in both men and women.

The incidence of stroke is also 1.25 times higher in men compared to women. This trend is noted in the local data in that there is a higher proportion of strokes in males as compared to females.

Ethnicity does play a role in stroke; with a wide range of incidences among the different race groups. Blacks are twice more likely to suffer from stroke with males at highest risk. However in the light of the geographical situation of the stroke service, this sector cannot be commented upon within the setting of Constantiaberg Mediclinic.

MODIFIABLE RISK FACTORS

Hypertension remains the leading modifiable factor linked to stroke. The risk is highest when the systolic BP ≥ 160 mmHg and / or diastolic BP ≥ 95 mmHg. This has been shown in the data gleaned from the database and tabulated above.

Patients suffering with Diabetes have the added problems of association with obesity, deranged cholesterol metabolism and an increased prevalence with

hypertension. It has been noted that women have a higher incidence of diabetes with related stroke than men³⁹. There is only a slight increase in females in this database (**27.91%** in females as compared to **26.09%** in males)

Atrial fibrillation is documented as the leading cardiac risk factor and this is borne out here as well with an overall rate of **22.96%** in stroke cases. Of note is that atrial fibrillation is linked to ischaemic stroke and not to intra-cerebral haemorrhage.

While smoking has been documented as a factor causing two times the risk of stroke, it was noted to be linked to **10.37%** of cases in the local service.

Dyslipidaemias have also been associated with an increased risk of CVA overall and the local figures shows that **27.41%** cases have some lipid derangement.

RADIOLOGICAL INVESTIGATIONS:

	CT SCAN WITHOUT CONTRAST	MR SCAN WITHOUT DWI
CEREBROVASCULAR ACCIDENTS	102	30
TRANSIENT ISCHAMEIC ATTACKS	9	0

CT scanning without contrast is the radiological test of choice for a very simple reason: it can be done quickly even if the patient has a depressed level of consciousness and is somewhat restless. Also it is easier done after hours and does not require the presence of the radiologist in the department.

Looking at the time of the day that the MRI scans are done, they are performed mainly when the neurologist and / or radiologist is there to correctly interpret the results and manage the cases appropriately.

DIAGNOSIS:

DIAGNOSIS	NUMBER OF CASES	PERCENTAGE
ISCHAEMIC STROKE OR INFARCTS	102	75.55%
LACUNAR STROKES	10	7.41%
HAEMORRHAGIC STROKES	13	9.63%
NOT KNOWN	10	7.41%

This distribution of types of strokes is in keeping with what has been determined in other centres, whereby Ischaemic strokes or infarcts account for more than 75 – 80% of all cases of CVA's.

A brief note on the last row wherein the diagnosis is not known: This is explained in those cases where the clinical diagnosis of CVA was made but no confirmatory radiological findings were obtained. Here, the patients had presented too late for the possibility of thrombolysis and the signs of CVA were well established.

LENGTH OF STAY:

AVERAGE LENGTH	6.65 DAYS
MAXIMUM LENGTH OF STAY	28 DAYS
MINIMUM LENGTH OF STAY	1 DAY

This detail, taken in isolation, may not seem to be of value. A trend of more importance would be to track whether the length of stay shortens over a time period. A number of other factors would need to be taken into consideration as to the significance of this: e.g., if the patients given thrombolytics have a shorter stay than others.

This finding is also important when considering the financial implications that are associated with the care and rehabilitation of stroke victims.

THROMBOLYSIS:

Only **15** cases (of a total of **135** cases) or **11.1%** were candidates receiving tPA in the time period under discussion. Of these **10** were male and **5** were female.

PATIENT NUMBER	TIME TO DOCTOR	TIME TO SCAN	TIME TO THROMBOLYSIS
4	1:40	2:20	3:02
7	2:45	1:30	4:30
25	0:25	0:40	1:35
30	1:25	1:45	2:00
43	0:55	1:40	3:20
54	2:25	3:20	4:45
55	1:00	1:30	2:16
60	1:45	1:50	2:30
69	0:35	1:25	2:45
73	1:15	2:05	2:50
79	1:40	2:00	2:40
86	1:30	2:20	3:50
88	1:40	2:10	2:45
91	1:00	1:10	2:15
122	0:50	1:35	2:40

Time is depicted as hr:min

TIME FACTOR:

The one important factor in these cases was the time factor for various stages in their illness:

- Time from onset to seeing the doctor in EC: this ranged from 25 minutes to 2 hours 45 minutes.

- Time from onset to scanning: this is between 40 minutes and 3 hours 20 minutes.
- Time to Thrombolysis: between 1 hour 35 minutes and 4 hours 30 minutes.

These time lines were well within the recommended times frames as advised by IST3 and borne out by the ECASS studies.

University of Cape Town

LENGTH OF STAY:

PATIENT NUMBER	LENGTH OF STAY	OUTCOMES
4	1	Home
7	4	Home
25	4	Home
30	1	Transfer to State Hospital
43	28	Step Down Facility
54	18	Deceased
55	10	Rehab centre
60	13	Deceased
69	2	Home
73	3	Deceased
79	4	Home
86	4	Home
88	4	Home
91	2	Home
122	1	Home

The length of stay ranged between 1 day and 28 days. The outcomes of these patients are linked to the length of stay; except in one case. The latter was a patient that was transferred to a State hospital on Day 1. Of the remaining patients, 9 were discharged home (here the length of stay was between 1 and 4 days). Three patients died while in hospital (death being on day 3, 13 and 18 respectively). One patient was referred to a step down facility after 28 days in hospital and one patient was transferred to a rehabilitation centre on day 10.

PROGRESS WHILE IN WARD

PATIENT NUMBER	mRS	NIHSS	status	Follow –up mRS	Follow –up NIHSS
4	0	2	Improved	0	0
7	0	4	Improved	2	1
25	0	12	Improved	1	2
30	0	16	unchanged	0	16
43	0	13	Improved	2	7
54	0	13	unchanged	-	5
55	0	11	Improved	-	3
60	0	15	worsened	-	26
69	0	2	Improved	0	-
73	1	20	deceased	-	-
79	0	12	Improved	1	-
86	0	5	Improved	3	3
88	0	12	Improved	2	3
91	0	3	Improved	1	1
122	0	7	Improved	0	0

Perusal of the above table on the condition of the patients while in ward showed that **11** of cases showed initial improvement of their neurological status, **2** remained unchanged, **1** patient's condition worsened and **1** died. This assessment was done on day 5 or on the day of discharge. A further two patients died after the initial assessment was performed.

CHAPTER SEVEN: SUMMARY, FURTHER THOUGHTS AND CHALLENGES

University of Cape Town

SUMMARY:

Examining all aspects of the stroke service model that have been developed at Constantiaberg Medi-Clinic and then comparing that with what has been described in some international sectors, it is obvious that the local version compares favourably.

Most of the elements required from a South African perspective for the establishment of a stroke centre are present and operational

When considering the basic elements required alone, it is easy to see that this service can be implemented wherever there are health care professionals dedicated enough to develop a similar unit.

When caring for stroke victims, time is of the essence. But by the same token, time spent with these individual patients is worth a tremendous amount on their road of rehabilitation back towards a normal to near-normal life.

The lessons learnt from the development of the service have been substantial. This project can easily be implemented within a hospital setting provided there are doctors that are prepared to be champions for the cause. Closer inspection of the make-up of the staff complement and the facility highlights that the project can readily utilize available personell provided there is enthusiasm and commitment to caring for CVA patients. What is also heartening is that the service can accommodate the recommendations mooted by the large international trials.

The challenges forward are exciting: the next step forward would be extend the follow-up of patients beyond the hospital stay and possibly onto the next 18 – 24 months. this would give a clearer picture of what outcomes can be obtained with ongoing physiotherapy and occupational therapy.

BIBLIOGRAPHY:

1. World Health Organisation (1978). *Cerebrovascular Disorders (Offset Publications)*. Geneva: [World Health Organization. ISBN 9241700432](#).
2. Ralph L. Sacco, Robert Adams, Greg Albers, Mark J. Alberts, Oscar Benavente, Karen Furie,, Larry B. Goldstein, Philip Gorelick, Jonathan Halperin, Robert Harbaugh, S. Claiborne Johnston, Irene Katzan, Margaret Kelly-Hayes, Edgar J. Kenton, Michael Marks, Lee H. Schwamm and Thomas Tomsick. (2006). Guidelines for Prevention of Stroke in Patients with Ischemic Stroke or Transient Ischemic Attack. *Stroke*. 37 (2), p577 - 617.
3. Various. (2009). *Stroke*. Available: <http://www.gpnotebook.co.uk/simplepage.cfm?ID=1295319040&linkID=8745&cook=yes>. Last accessed 20 November 2009.
4. National Collaborating Centre for Chronic Conditions. *Stroke: national clinical guideline for diagnosis and initial management of acute stroke and transient ischaemic attack (TIA)*. London: Royal College of Physicians, 2008
5. MacKay. Mensah, G.. (2004). *Global burden of stroke*. Available: http://www.who.int/cardiovascular_diseases/en/cvd_atlas_15_burden_stroke.pdf. Last accessed 20 November 2009.
6. Bryer, A; Connor, M (2006). *Chronic Diseases of Lifestyle in South Africa: 1995 - 2005*. South Africa: Medical Research Council. p195 - 203.
7. Kathleen Kahn, Stephen M Tollman. (1999). Stroke in rural South Africa - contributing to the little known about a big problem. *South African Medical Journal*. 89 (1), p63 - 65.
8. The SASPI Project Team. (2004). Prevalence of Stroke Survivors in Rural South Africa. *Stroke*. 35 (3), p627 – 633.
9. Prof. V Fritz. (2000). Stroke Therapy Clinical Guideline. *South African Medical Journal*. 90 (3), p276 - 306.
10. World Health Organisation. (2009). *World Data Table*. Available: http://www.who.int/cardiovascular_diseases/en/cvd_atlas_29_world_data_table.pdf. Last accessed 08 November 2009.

11. Rosana Norman, Debbie Bradshaw, Michelle Schneider, Jané Joubert, Pam Groenewald, Simon Lewin, Krisela Steyn, Theo Vos, Ria Laubscher, Nadine Nannan, Beatrice Nojilana, Desirée Pieterse and the South African Comparative Risk Assessment Collaborating Group. (2007). A comparative risk assessment for South Africa in 2000: Towards promoting health and preventing disease. *South African Medical Journal*. 97 (7), p637 - 641.
12. Milne, F. J, Pinkney-Atkinson, V.J. (2004). Hypertension Guideline 2003 Update. *South African Medical Journal*. 94 (3), 209 - 226.
13. Seedat, Y.K., Croasdale, M.A., Milne, F.J., Opie, L.H., Pinkney-Atkinson, V.J., Rayner, B. L., Veriava, Y. (2006). South African Hypertension Guideline 2006. *South African Medical Journal*. 96 (4), p337 - 362.
14. SEMDSA. (1997). Guidelines for the management of type II (non-insulin-dependent) diabetes mellitus at primary health care level in South Africa. *South African Medical Journal*. 87 (4), p497 - 512.
15. South African Medical Association and Lipid and Atherosclerosis Society of Southern Africa Working Group. (2000). Diagnosis, management and prevention of the common dyslipidaemias in South Africa - clinical guideline, 2000. *South African Medical Journal*. 90 (2), p164 - 178.
16. Various. (2009). *Anterior Cerebral Artery*. Available: http://en.wikipedia.org/wiki/Anterior_cerebral_artery. Last accessed 23 November 2009.
17. Elias A. Giraldo. (2007). *Introduction: Stroke (CVA)*. Available: <http://merck.com/mmpe/sec16/ch211/ch211a.html>. Last accessed 11 September 2009.
18. National Stroke Foundation. (2007). *Clinical Guidelines for Acute Stroke Management*. Available: <http://www.strokefoundation.com.au/images/stories/healthprofessionals/clinical%20guidelines%20for%20acute%20stroke%20management.pdf>. Last accessed 11 May 2009.
19. Various. (2009). *The Paul Coverdell National Acute Stroke Registry*. Available: http://www.cdc.gov/dhdsp/stroke_registry.htm. Last accessed 28 November 2009.
20. Pamela W. Duncan, Richard Zorowitz, Barbara Bates, John Y. Choi, Jonathan J. Glasberg, Glenn D. Graham, Richard C. Katz, Kerri Lamberty, Dean Reker. (2005). Management of Adult Stroke Rehabilitation Care. *Stroke*. 36 (9), p e100 -e143.

21. Edward C. Jauch, ; Brett Cucchiara, ; Opeolu Adeoye; William Meurer; Jane Brice; Yvonne (Yu-Feng) Chan; Nina Gentile; Mary Fran Hazinski . (2010). Part 11: Adult Stroke; 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care . *Circulation*. 122 (183), s818-828.
22. Mark J. Alberts, MD; George Hademenos, PhD; Richard E. Latchaw, MD; Andrew Jagoda, MD; John R. Marler, MD; Marc R. Mayberg, MD; Rodman D. Starke, MD; Harold W. Todd; Kenneth M. Viste, MD; Meighan Girgus; Tim Shephard, MD; Marian Emr; Patti Shwayder, MPA; Michael D. Walker, MD; for the Brain Attack Coalition . (2000). Recommendations for the Establishment of Primary Stroke Centers. *The Journal of the American Medical Association*. 283 (23), 3102-3109.
23. Mark J. Alberts MD*; Richard E. Latchaw MD; Warren R. Selman MD; Timothy Shephard RN; Mark N. Hadley MD; Lawrence M. Brass MD; Walter Koroshetz MD; John R. Marler MD; John Booss MD; Richard D. Zorowit. MD; Janet B. Croft, PhD; Ellen Magnis, MBA; Diane Mulligan; Andrew Jagoda, MD; Robert O'Connor, MD; C. Michael Cawley, MD; J.J. Connors, MD; Jean A. Rose-DeRenzy, CN, RN; Marian Emr; Margo Warren; Michael D. Walker, MD for the Brain Attack Coalition. (2005). Recommendations for Comprehensive Stroke Centers. A Consensus Statement From the Brain Attack Coalition . *Stroke: Journal of the American Heart Association*. 36 (7), p1597-1616.
24. Department of Health. (2007). *National Stroke Strategy*. Available: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/PublicationsPolicyAndGuidance/DH_081062. Last accessed 11 May 2009.
25. Helen M. Dewey, PhD; Amanda G. Thrift, PhD; Cathy Mihalopoulos, BSc (Hons), PGradDHE; Robert Carter, MAS; Richard A.L. Macdonell, MD; John J. McNeil, PhD Geoffrey A. Donnan, MD . (2001). Cost of Stroke in Australia From a Societal Perspective. *Stroke*. 32 (10), 2409 - 2416.
26. Thomas N. Taylor, PhD; Patricia H. Davis, MD; James C. Torner, PhD; Julia Holmes, PhD, MSW; Jay W. Meyer, MS Mark F. Jacobson, BS . (1996). Lifetime Cost of Stroke in the United States. *Stroke*. 27 (9), 1459 - 1466.
27. Deborah J. Webb, Pierre B. Fayad, Christine Wilbur, Angela Thomas, Lawrence M. Brass. (1995). Effects of a Specialized Team on Stroke Care. *Stroke*. 26 (6), p 1353-1357.

28. Stroke Unit Trialists' Collaboration. Organised inpatient (stroke unit) care for stroke. *Cochrane Database of Systematic Reviews* 2007, Issue 4. Art. No.: CD000197. DOI: 10.1002/14651858.CD000197.pub2
29. Anita Patel, Martin Knapp, Inigo Perez, Andrew Evans and Lalit Kalra. (2004). Alternative Strategies for Stroke Care: Cost-Effectiveness and Cost-Utility Analyses From a Prospective Randomized Controlled Trial. *Stroke*. 35 (1), p 196 - 203.
30. Alberts, et.al. (2005). Recommendations for Comprehensive Stroke Centers: A Consensus Statement from the Brain Attack Coalition. *Stroke*. 36 (7), p 1597-1616.
31. Various. (2009). *Modified Rankin Scale*. Available: <http://strokecenter.org/trials/scales/rankin.html>. Last accessed 22 November 2009.
32. Rankin J. "Cerebral vascular accidents in patients over the age of 60." *Scott Med J* 1957;2:200-15.
33. Bonita R, Beaglehole R. "Modification of Rankin Scale: Recovery of motor function after stroke." *Stroke* 1988 Dec;19(12):1497-1500.
34. Van Swieten JC, Koudstaal PJ, Visser MC, Schouten HJ, van Gijn J. "Interobserver agreement for the assessment of handicap in stroke patients." *Stroke* 1988;19(5):604-7.
35. Various. (2009). *NIH Stroke Scale (NIHSS)*. Available: <http://strokecenter.org/trials/scales/nihss.html>. Last accessed 22 November 2009
36. Rothwell P, Giles M, Flossmann E, Lovelock C, Redgrave J, Warlow C, & Mehta Z (2005). A simple tool to identify individuals at high early risk of stroke after a transient ischaemic attack: the ABCD score. *The Lancet*, **366**:29-36.
37. Stephan A. Mayer et.al. (2008). Efficacy and Safety of Recombinant Activated Factor VII for Acute Intracerebral Hemorrhage. *New England Journal of Medicine*. 358 (20), p 2127-2137.
38. The Directorate: Chronic Diseases, Disabilities and Geriatrics (2001). *National Guideline on Stroke and Transient Ischaemic Attacks*. South Africa: Department of Health. p 1 - 22.
39. Ralph L. Sacco, MD, MS, Chair; Emelia J. Benjamin, MD, ScM; Joseph P. Broderick, MD; Mark Dyken, MD; J. Donald Easton, MD; William M. Feinberg, MD; Larry B. Goldstein, MD; Philip B. Gorelick, MD, MPH; George Howard, DrPH; Steven J. Kittner, MD, MPH; Teri A. Manolio, MD,

- MHS; Jack P. Whisnant, MD; Philip A. Wolf, MD. (1997). Risk Factors. *Stroke: Journal of the American Heart Association*. 28 (8), p1507-1517.
40. Dr Martin J O'Donnell PhD; Prof Denis Xavier MD ; Prof Lisheng Liu MD; Prof Hongye Zhang MD; Siu Lim Chin; Purnima Rao-Melacini MSc; Sumathy Rangarajan MSc; Shofiquil Islam MSc; Prof Prem Pais MD; Prof Matthew J McQueen MBChB; Charles Mondo MD; Prof Albertino Damasceno MD; Prof Patricio Lopez-Jaramillo MD; Prof Graeme J Hankey FRACP; Prof Antonio L Dans MD; Prof Khalid Yusoff FRCP; Thomas Truelsen DMSc; Prof Hans-Christoph Diener MD; Prof Ralph L Sacco MD; Prof Danuta Ryglewicz MD; Prof Anna Czlonkowska MD; Prof Christian Weimar MD; Prof Xingyu Wang PhD; Prof Salim Yusuf DPhil; on behalf of the INTERSTROKE investigators† (2010). Risk factors for ischaemic and intracerebral haemorrhagic stroke in 22 countries (the INTERSTROKE study): a case-control study. *The Lancet*. 376 (9735), p112-123.
 41. Carole L. Hart, MA; David J. Hole, MSc; George Davey Smith, MD. (2000). Comparison of Risk Factors for Stroke Incidence and Stroke Mortality in 20 Years of Follow-Up in Men and Women in the Renfrew/Paisley Study in Scotland. *Stroke: Journal of the American Heart Association*. 31 (8), p1893-1896
 42. Marler JR, Tilley BC, Lu M, Brott TG, Lyden PC, Grotta JC, Broderick JP, Levine SR, Frankel MP, Horowitz SH, Haley EC Jr, Lewandowski CA, Kwiatkowski TP.. (2000). Early stroke treatment associated with better outcome: the NINDS rt-PA stroke study.. *Neurology*. 55 (11), p1649- 1655.
 43. Hacke W, Donnan G, Fieschi C, Kaste M, von Kummer R, Broderick JP, Brott T, Frankel M, Grotta JC, Haley EC Jr, Kwiatkowski T, Levine SR, Lewandowski C, Lu M, Lyden P, Marler JR, Patel S, Tilley BC, Albers G, Bluhmki E, Wilhelm M, Hamilton S; ATLANTIS Trials Investigators; ECASS Trials Investigators; NINDS rt-PA Study Group Investigators. (2004). Association of outcome with early stroke treatment: pooled analysis of ATLANTIS, ECASS, and NINDS rt-PA stroke trials.. *The Lancet*. 363 (9411), p768-774.
 44. Peter Sandercock, Richard Lindley, Joanna Wardlaw, Martin Dennis, Steff Lewis, Graham Venables, Adam Kobayashi, Anna Czlonkowska, Eivind Berge, Karsten Bruins Slot, Veronica Murray, Andre Peeters, Graeme Hankey, Karl Matz, Michael Brainin, Stefano Ricci, Maria Grazia Celani,

Enrico Righetti, Teresa Cantisani, Gord Gubitz, Steve Phillips, Antonio Arauz, Kameshwar Prasad, Manuel Correia, Phillippe Lyrer, and the IST-3 collaborative group. (2008). *The third international stroke trial (IST-3) of thrombolysis for acute ischaemic stroke*. Available: <http://www.ncbi.nlm.nih.gov/pmc/articles/PMC2442584/>. Last accessed 14th April 2011.

45. Saver JL, Gornbein J, Grotta J, Liebeskind D, Lutsep H, Schwamm L, Scott P, Starkman S.. (2009). Number needed to treat to benefit and to harm for intravenous tissue plasminogen activator therapy in the 3- to 4.5-hour window: joint outcome table analysis of the ECASS 3 trial. *Stroke: Journal of the American Heart Association*. 40 (7), p2433-2437.

BIBLIOGRAPHY USED AS BACKGROUND READING:

Cother Hajat, et.al. (2011). Incidence of aetiological subtypes of stroke in a multi-ethnic population based study: the South London Stroke Register. *The Journal of Neurology, Neurosurgery, and Psychiatry*. 85 (5), p527-533.

Adam Kobayashi, MD, PhD; Joanna M. Wardlaw, MBChB, MD, FRCR, FRCP, FMedSci; Richard I. Lindley, MD, FRCP, FRACP; Steff C. Lewis, PhD, MSci; Peter A.G. Sandercock, DM, FRCPE, FMedSci; Anna Czlankowska MD, PhD on behalf of the IST-3 Collaborative Group,. (2009). Oxfordshire Community Stroke Project Clinical Stroke Syndrome and Appearances of Tissue and Vascular Lesions on Pretreatment CT in Hyperacute Ischemic Stroke Among the First 510 Patients in the Third International Stroke Trial (IST-3). *Stroke: Journal of the American Heart Association*. 40 (3), p743-748.

Harold P. Adams, Jr, MD, Chair; Thomas G. Brott, MD; Anthony J. Furlan, MD; Camilo R. Gomez, MD; James Grotta, MD; Cathy M. Helgason, MD; Thomas Kwiatkowski, MD; Patrick D. Lyden, MD; John R. Marler, MD; James Torner, PhD, Members; William Feinberg, MD; Marc Mayberg, MD; William Thies, PhD, Ex Officio Members . (1996). Guidelines for Thrombolytic Therapy for Acute Stroke: A Supplement to the Guidelines for the Management of Patients With Acute Ischemic Stroke . *Circulation*. 94 (5), p1167-1174.

Saver JL, Gornbein J, Grotta J, Liebeskind D, Lutsep H, Schwamm L, Scott P, Starkman S.. (2009). Numbers needed to treat to benefit and to harm for intravenous tissue plasminogen activator therapy in the 3- to 4.5-hour window: joint outcome table analysis of the ECASS 3 trial.. *Stroke: Journal of the American Heart Association*. 40 (7), p2433-2437.

Werner Hacke, M.D., Markku Kaste, M.D., Erich Bluhmki, Ph.D., Miroslav Brozman, M.D., Antoni Dávalos, M.D., Donata Guidetti, M.D., Vincent Larrue, M.D., Kennedy R. Lees, M.D., Zakaria Medeghri, M.D. Thomas Machnig, M.D., Dietmar Schneider, M.D., Rüdiger von Kummer, M.D., Nils Wahlgren, M.D., and Danilo Toni, M.D. for the ECASS Investigators, . (2008). Thrombolysis with Alteplase 3 to 4.5 Hours after Acute Ischemic Stroke. *The New England Journal of Medicine*. 359 (13), p1317-1329.

Edward C. Jauch, ; Brett Cucchiara, ; Opeolu Adeoye; William Meurer; Jane Brice; Yvonne (Yu-Feng) Chan; Nina Gentile; Mary Fran Hazinski . (2010). Part 11: Adult Stroke; 2010 American Heart Association Guidelines for Cardiopulmonary Resuscitation and Emergency Cardiovascular Care . *Circulation*. 122 (183), s818-828.

Advisory Working Group: Robert Adams, MD, Chair; Joe Acker, EMT-P, MPH; Mark Alberts, MD; Liz Andrews; Richard Atkinson, MD; Kathy Fenelon; Anthony Furlan, MD; Meighan Girgus; Katie Horton, RN, MPH, JD. Richard Hughes, MD; Walter Koroshetz, MD; Richard Latchaw, MD; Ellen Magnis; Marc Mayberg, MD; Arthur Pancioli, MD; Rose Marie Robertson, MD; Tim Shephard, RN; Renee Smith; Sidney C. Smith, Jr, MD; Suzanne Smith; Steven K. Stranne, MD, JD ASA Standing Advisory Committee;; Edgar J. Kenton, III, MD, Chair; Joe Acker, EMT-P, MPH; Robert Adams, MD; Gil Bashe; Altagracia Chavez, MD; Larry B. Goldstein, MD; Richard Hodosh, MD; Richard Hughes, MD; Cindy Keitel, MBA; Margaret Kelly-Hayes, EdD, RN, FAAN; Richard Latchaw, MD; Anne Leonard, RN, BSN, MPH; Lewis Morgenstern, MD; Arthur Pancioli, MD; Jack Owen Wood (2002). Recommendations for Improving the Quality of Care Through Stroke Centers and Systems: An Examination of Stroke Center Identification Options . *Stroke: Journal of the American Heart Association*. 333 (1), e1-7.

LIST OF ADDENDA

1.	Global Burden of Stroke	16
2.	Deaths from Stroke	17
3.	Acute Stroke Proforma	76

University of Cape Town

LIST OF TABLES:

1.	Country Comparison Table.	18
2.	Risk Factors Table and Treatment Guidelines	25
3.	Neuro-Anatomic Syndromes of Stroke.	28
4.	Modified Rankin Score	56
5.	National Institute of Health Stroke Scale	58-60
6.	ABCD ² score for Transient Ischaemic Attacks.	61
7.	Comparison between CT scan and MRI scan in Stroke	72
8.	Description of drugs used in Stroke	73
9.	Comparison between South African model and the local model	80
10.	Comparison between Stroke Models	85

University of Cape Town

LIST OF FIGURES AND DIAGRAMS:

1.	Pyramidal view of the care levels required for stroke victims	14
2.	Simplistic Classification of Cerebrovascular Accidents	26
3.	Vascular Supply to the Brain	27
4.	Approach to Cerebrovascular Disease	57
5.	Approach to Ischaemic Strokes	82
6.	Approach to Haemorrhagic Strokes	83
7.	Approach to Transient Ischaemic Attack	84

University of Cape Town

LIST OF COMMONLY USED ABBREVIATIONS:

ABBREVIATION	FULL EXPLANATION
ACA	Anterior Cerebral Artery
BAC	Brain Attack Coalition
BP	Blood Pressure
CDC	Centre for Disease Control
CSC	Comprehensive Stroke Centre
CT scan	Computerised Tomography scan
CVA	Cerebrovascular Accident
DALYS	Disability Adjusted Life Years
ECASS	European Cooperative Acute Stroke Study
ECG	Electrocardiogram
EMS	Emergency Medical Services
FP	Family Practitioner
GP	General Practitioner
ICA	Internal Carotid Artery
IST	International Stroke Trial
LASSA	Lipid and Atherosclerosis Society of South Africa
LDL	Low Density Lipids
LDLC	Low Density Lipoprotein Cholesterol
M&M	Mortality and Morbidity
MCA	Middle Cerebral Artery
MRA	Magnetic Resonance Angiography
MRC	Medical Research Council
MRI	Magnetic Resonance Imaging scan
NHS	National Health System
NMES	National Medical Expenditure Survey
NSS	National Stroke Strategy
PCA	Posterior Cerebral Artery
PCNSR	Paul Coverdell National Stroke Registry
PSC	Primary Stroke Centre
SAH	Sub Arachnoid Haemorrhage
TIA's	Transient Ischaemic Attacks.
tPA	Alteplase
UK	United Kingdom
USA	United States of America
WHO	World Health Organisation